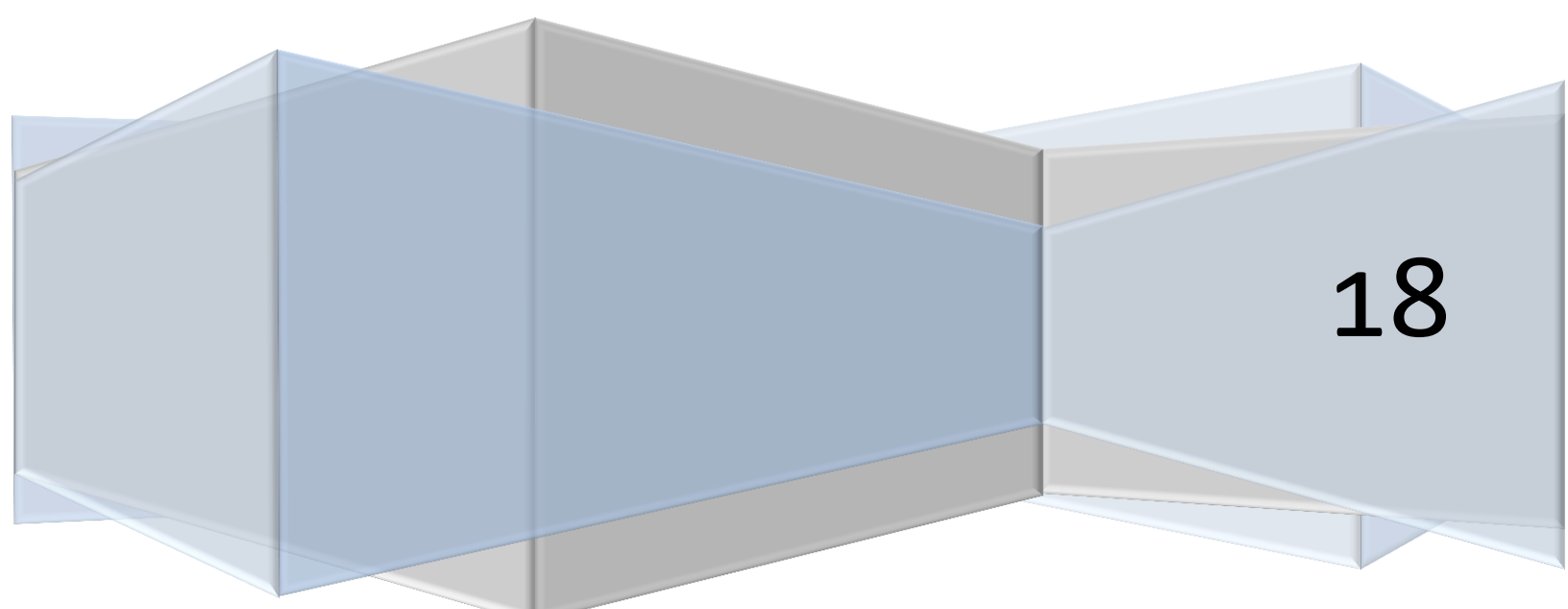


Economic Institute Banja Luka

MULTIPLICITIES

Choices for animate and inanimate

Rastko Vuković



18

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Goran Dakić – gramatika,
Duško Milinčić – informatika,
Aleksandra Radić – fizika.

Foreword

The following texts I wrote by looking at the reviews of the book "Quantum Mechanics" (see [1]). Here are a part of the themes discussed differently, almost completely without the formulas, but also the themes from two other books: Space-time [2] and "Information of perception" [3]. Much earlier came out the book "Nature of Data" [4], as a philosophical aspect of its previous "Mathematical Theory of Information and Communication" [5]. Unlike the first two books with seemingly independent themes, the next three are one story in three sequels.

The narrower goal of writing is the motivation at some future researchers that could perhaps appear with the easier aspect of these difficult problems. That is why you will find in the text some kind of inspirational "evidence", unlike those "proves" that are stodgy which are sufficient in my other works. I consider them to be interesting additions to the theory itself, and not as a fault. It is a primary desire to draw closer to this issue and to unacquainted readers.

This is the theory of the substantial world of physics, which is a very negligible part of worldly laws, temporarily called reality within pseudo-reality, and then about living beings that are almost insignificant parts of the entire material environment. It is an attempt to connect mathematics, physics and life to an exact, or at least in a serious natural-philosophical way.

Rastko Vuković,
Banja Luka, summer, 2018.

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Supreme Will

When with the army he crossed the Rubicon River 49 years before the new era, the border between the Roman provinces and the Cisalpine Gaul, Gaius Julius Caesar allegedly said: "Alea iacta est!" (The cube



was thrown). He was already a glorified military leader in subjugation the great parts of Western Europe, and now he violated the Senate's law intended to protect Rome from internal military threats. Perhaps his personal or later narrators who justified the general, adding to him the aforementioned legendary statement, wanted to say that destiny had so decided, taking away part of his responsibility for the events that followed.

Many senators left Rome because they did not know that Caesar had only one legion with him against Pompey, the war veteran of Rome, who at

that time had a much larger army, to whom Caesar offered negotiations and the possibility of renewing the alliance. As we know, Pompey rejected that offer and, after defeating the battle at Pharsalus, fled to Egypt. Caesar then defeated Ptolemy XIII at Battle of the Nile and left the administration of Egypt to Cleopatra VII. He then defeated the Kingdom of Pontus in the battle of Zela, 47 BC. After this battle, to the Senate he sent a famous message: "Veni, vidi, vici!" (I came, I saw, I won). In the meantime, Pompey was killed in Egypt by an order from Potinus, a Pharaoh's eunuch.

From about 509 BC and to the Caesar, more precisely to the reform carried out by Octavian Augustus in the last three decades of the first century BC, the Roman state was the Republic. Then it became the Empire, which in the west lasted until 476, and in the east until the fall of Byzantium in 1453.

The accusation of the dice for Caesar's crossing of Rubikon tells us something about the religiousness of the Romans. The Senate (Latin *Senatus*) or the senior council was developed from a larger tribal chiefs. It is an old Roman institution, which had great reputation and power during the kings, and during the reign of the Republic to the reign of Caesar the Senate's opinion was a supreme sanction. There were the decisions on finances, war policy, provincial administrations, and religious issues. The Romans took the rites of many deities of the people under their authority, fearing the divine anger, both against the individual and against the state.

Telling the Romans that it had decided the dice meant to impose its decision on fate and will higher than the Senate. In this way of violating the Senate's laws, the genius of the statement "the cube was thrown out" is reflected, so Caesar can indeed say it. If the Senate has ever tried to manipulate the people with the help of the gods, then he himself was manipulated.

In addition to the gods, senators and dictators, an important part of Rome's authority was Roman law. It is based on the Law of Twelve Plates (Lat. *Leges Duodecim Tabularum*), a collection that remained unchanged throughout the entire duration of Rome. The original text of the Law of the twelve tables is not preserved, but there are copies. The Romans were fanatically loyal to their laws until the end. They were taught by them in schools, and all the important Roman lawyers quoted them in their works.

Authority

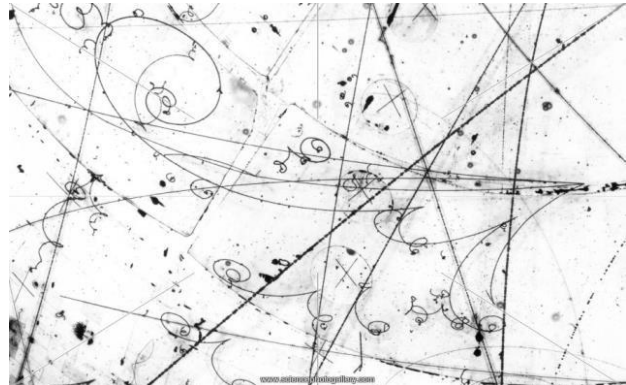
The authority (lat. *auctoritas*) usually means the concept of the fundamental right to exercise power, which the state can formalize and give to judges, monarchs, rulers, police officers, other appointed governors, or church or priestly appointed representatives of more spiritual force (God or other deities). The term "authority" also denotes academic knowledge of a particular field (authority in a given subject) or refers to an original or natural obligation (father's authority).

What is emphasized here is the ability of the authority to be a decision-making criterion, that it can be an obstacle to arbitrariness, that is, it is able to limit and direct freedom.

Abstained from the bearer, the authority itself represents an objective phenomenon. Like a stone that is once an obstacle on the road, and sometimes useful building material. With academic knowledge we write more professional books, we attract religious believers with religious authority, we treat a police officer differently than other citizens who would require of us to identify. The reign of Caesar's military commander when he crossed Rubicon seemed to be senators fleeing Rome, not even knowing how many troops he had with himself, even before the first conflict took place. In the same sense, it is the objective and what we do when there is no ban.

The objectivity is a central philosophical concept. Objective objects are defined as independent of perceptions, so objectivity means the ability to be "independent of our power," which is somewhat imprecise for interpretations that we need in theoretical physics and mathematics. As an improvement of such a definition we say that it is objectively "what can influence" our decisions, behavior or the environment.

The particles interacting are reciprocally changing, depending one on the other, so we say that they are mutually objective. If the first and second particles are mutually objective, and also the second and third, then the first and third particles are mutually objective. Formally we say that objectivity is a transitive (transferable) relation. The ability of mutual interaction is symmetrical so that objectivity is symmetrical. Finally, when we consider each occurrence itself objective, it is objectivity also reflexive. A relation that is reflexive, symmetric, and transitive in algebra is called a relation of equivalence. It's similar with the "be real" relationship.



Objectivity and reality we define by interaction, but reality and interaction are not identical terms. This will be easier to understand when we note that two photons (light particles) do not interact with one another, and that the photon and electron (particle of negative charge) interact. Since the first photon and electron interact, they are mutually realistic, and electron and other photons are also realistic, and two photons are interacting, due to transition, although they still do not interact directly.

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The reality defined in this way, by the ability of mutual influence, is relative. When the first subject is selected, the element of reality, the set of all real elements is formed so that they are real compared to the initial one. This means that it is formally possible to conceive the existence of "paralelal realities", sets that constitute mutually real elements, but no element in one of such sets is realistic with any element from another set. However, one element can be beyond the reach of the influence of the other, and that is not the opposite. For these reasons, we also need the concept of pseudo-reality.

The gods are pseudo-real, if they really exist so they are untouchable for us, but they can affect our destiny. Pythagoras theorem¹ is pseudo-real. Every mathematical truth and natural law can affect us, but we can not change them, and therefore we say that they are pseudo-real. Pseudo-real is the past. It will be shown that this "exaggeration" with precision can help in understanding the physical world.

From the above examples we find out how practical to observe authority from the point of view of influence on others, or as the ability to direct other people's freedoms.

In the same way explained, by the interaction of physical particles, the money becomes objective. The value of money can change us and our environment, but we can also produce some of our own moneta



value, that is to change our company's value, and thus the very definition of the money. When we remove coins and banknotes, which in the modern world become less and less important carriers of money, its value is a mental thing that exists exclusively in the common human imagination. Money is arranged as a fictitious replacement tool that allows people to turn a lot of values into many. Since the guarantor of the exchange is a state, money becomes a kind of authority. In addition, from indirect funds, money can be a purpose to itself, for

example in banking or for people who acquire it without thinking about its actual replacement.

Thus we come to understand the next trait of authority – lifeness. Like Caesar, a senator or any living being who does not want to die, an abstract authority will show at least a negligible little such character. In the case of Roman law, we see this in the obligation to apply. For example, the first table of the Law states: "If someone is summoned to court, let him go. If he does not come, let the witnesses be summoned, then let them bring him. If he tries to deceive or run, let them bring him." Today's right is even more lively for adjusting to current circumstances and increasing.

We define a living being as the one that can make decisions. We do not define the concept of decision, except as choosing one of the more options. Therefore, this approach is not essential, where on each "because" is put a new "why", but formal. When we stop asking what is collected and start dealing with the abstraction of the numbers themselves, then we stop to deal with the philosophy of quantities and move on to the algebra.

¹ "The square above the hypotenuse, every child knows it, is equal to the sum of the squares above both catheti" - Branislav Nusic, Autobiography, see [6].

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Nevertheless, whatever the decisions and methods of making are, the definition implies that there exist options. And they are really immanent, in various ways. We know hundreds of proofs of the same Pythagoras theorems. Mathematics testifies that it is possible in different correct ways from the unique truths to perform some other unique truths. There are various theorems, various monetary values, various authorities that compete for supremacy, so it is justified to imply that exist, in general, the different choices.

Arrow's² theorem of impossibility demonstrates the powerlessness of the criterion, since the notion of "best" choice is more often unclear than we expect. Let's consider this in the example in the following table. Let's say each of the X, Y, Z commissions makes its top-list of candidates A, B, C, as in the table. For Commission X, the best the candidate is A, the worst C. For the commission Y the best is C, the worst B, and for the commission Z the best is B, the worst A. Candidates can be politicians, jobseekers, companies on the tender.

	A	B	C
X	1	2	3
Y	2	3	1
Z	3	1	2

The score is unresolved, so we look at the pairs. Choosing between A and B, Commission X will opt for A, Commission Y also for A, but the commission Z for B, then wins A by a vote of 2: 1. Similar voting in pairs B with C wins B, and in A v C will win C. So, candidate A is better than candidate B, candidate B is better than candidate C, and candidate C is better than candidate A. Again unresolved!

The very simplified example, but sufficient to understand the weakness of the criteria, especially in the case overcomes some "little things" in the crowd. That's why the richest are not always the best students of economics, neither are the most original those with the "necessary" qualifications. So we see "verified" and tucked up programs for economic or other development, and the thing is not going, again and again, and then suddenly someone else "unfair" appeared as successful. In the lack of understanding of the limitations of the criteria, theories of conspiracy also emerged, and many other misconceptions. But what we have from all of this, however, is the conclusion that the elections and opportunities can exist where we do not ask them.

The long history of Rome began with the Law twelve tables, with the idea of equality³, to which supervened the Senat. After several hundred years, after Caesar, Rome's supreme will was imperators, in order to move the authority to Christianity and promote the equality of people before God, at the end of the empire. Over the next centuries, the authority of the Catholic Church grew on the west to the Inquisitions then to the new ideas of freedom and equality. It was a long period of rule by monarchy. Now, after these experiences and the discovery of the Arrow's theorem of impossibility, we know that there is no need to hurry with an assessment of which of these social systems was the best.

² Kenneth Arrow (1921-2017), American mathematician.

³ First table, paragraph 4: For servants and slaves, for eminent and proprietors, let the same law apply.

Differences

The world is governed by immutable laws from which we have just met a small part, but sufficient for understanding that we can hardly see an enormous variety of diversity. The first part of this the sentences go with Gedel's⁴ theorem on completeness, which he proved in 1929, and which is not the subject of this subtitle: "In the first-order logic⁵, every logically valid formula is provable". The second part of this sentence, which is now more interesting for us, expresses the essence of Gedel the theorems on incompleteness from 1931. I paraphrase: "For any formal theory that confirms the basic arithmetic truths, the arithmetic claim that can be constructed true but not provable assertion within that theory itself." In other words, any theory that is capable of expressing elementary arithmetic can not be at the same time consistent and complete. The extent of these infinities, of course, is not only in numbers, but the numbers are most famous therefore the most convenient objects for the story of diversity.

A set of natural numbers, in mathematics marked with $\mathbb{N} = \{1,2,3,\dots\}$, makes "countable infinite" many different elements. Their quantity, which for infinite sets is called the "cardinal number", is denoted by (alef zero). In this very description, there are several very math expressions that I will try to explain with minimal mathematics. The first surprise for a non-mathematician is that the problem with understanding the theorem are not even close to the bare formulas, labels or definitions as how much the mathematical thinking is. First of all, it is the understanding of the proof.

$1 \cdot 8$	$=$	8
$11 \cdot 88$	$=$	968
$111 \cdot 888$	$=$	98568
$1111 \cdot 8888$	$=$	9874568
$11111 \cdot 88888$	$=$	987634568
$111111 \cdot 888888$	$=$	98765234568
$1111111 \cdot 8888888$	$=$	9876541234568
$11111111 \cdot 88888888$	$=$	987654301234568
$111111111 \cdot 888888888$	$=$	98765431901234568
$1111111111 \cdot 8888888888$	$=$	987654321791234568

Unlike natural and social sciences, mathematics deals with absolute truths and only with them. How is it possible? Absolute truths do not exist this is something that can be heard from the makers of politics, social events or law – because truth is relative, sometimes like this, and sometimes like that. However, ancient Greeks resolved this problem of "relative" truth long ago by noting that the both, true and false, can be derived from the false by accurate deduction, but from the true can be derived only true. And there are the door to finding out the absolute truth that nature has torn off.

When we can derive from the precondition precisely the true and the opposite, the false assertion, then we say that we come to a contradiction and conclude that the negation of the assumption is true. If the assumption is in the contradiction, it is incorrect, but its negation is true, because the third one does not exist (lat. *tertium non datur*). This is the essence of proving by the method of contradiction, discovered in the ancient Greece, which in the beginning of mathematics was almost the only and used. That's why for the mathematicians are so important assumptions, unlike to the other researchers.

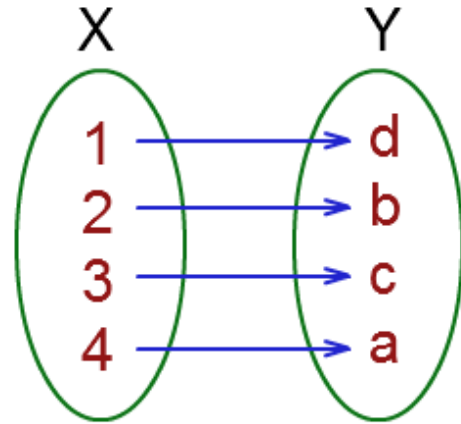
⁴ Kurt Gödel (1906-1978), Austrian-American mathematician.

⁵ First-order logic or first-order predicate calculus is a formal system used in mathematics, philosophy, linguistics and computing.

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Let's look now at why we say that the numbers in the set \mathbb{N} have countable infinite. Let's say to count the balls in the box. We detach one by one. When we draw the first ball we say "one", when we draw the second we say "two", with the third we say "three" and so on, no matter how many balls are in, the natural numbers can not be missing. So we say that a set of natural numbers is infinite, and we say it's countable because we can count them.

Formally, counting is a mutually univocal joining of natural numbers in the order of the elements of a given set, as in the figure on the right. Whenever we can count the elements of one set with the elements of the second set, and if no element in any of the two sets is left over or missing, then we say that these two sets have the same number of elements. Joining is also called mapping, and this mutual univocal mapping is also called bijection. The concept of mapping is so simple that it is transmitted directly to infinite sets, with the amount of elements of infinite sets known as cardinal numbers. The first smallest of cardinal numbers is the mentioned alef zero.



The set of integers, $\mathbb{Z} = \{..., -2, -1, 0, 1, 2, ...\}$, has the same number of elements as the set \mathbb{N} , that is, alef zero. This is visible when we write whole numbers in the form of a countable string, $\mathbb{Z} = \{0, 1, -1, 2, -2, ...\}$, which can thus be "counted", which means joining a set of natural numbers in a bijection manner. We will further prove that both the fractions with integer numerator and natural denominator also have \aleph_0 . We call such fractions rational numbers, and their set is denoted by the letter \mathbb{Q} .

Each rational number can be written in the form $\frac{z}{n}$ where the denominator (bottom) is any natural number, and the numerator (upper) of any integer. Let's just look at the positive fractions, and only those whose sum of numerator and denominator has the constant values $k = z + n$ in order. For example, for $k = 5$ we have four fractions $\frac{1}{4}, \frac{2}{3}, \frac{3}{2}, \frac{4}{1}$. It is clear that getting the numbers $k = 2, 3, 4, \dots$

we get all possible positive rational records, without not even one of them reporting twice. We can pull them down for counting. Therefore, a set of positive rational numbers is countably infinite. When we put zero at the beginning of this string, and beside every positive one insert its negative fraction, again we get a countable infinite series. Thus we prove that \aleph_0 is the cardinal number and set \mathbb{Q} . This proves were simple because the simple were assumptions, they were obvious enough that the method of contradiction was not needed.

The next larger set consists of irrational numbers. These are the roots of naturals that are not square of some integers (as $\sqrt{2} = 1.42421\dots$), or transcendental numbers (as $\pi = 3.14159\dots$, or $e = 2.71828\dots$), which are not solutions of polynomials, so called algebraic, equations. We will prove that there are more than \aleph_0 . When we to irrational numbers add the rational (fractions), we get the set of real numbers, labeled \mathbb{R} . It is not surprising that the set of real numbers has the same cardinal number as the set of irrational ones, because shaking the washbowl of water in the lake it still remains a lake. It is a little

strange that there is a bijection between all real numbers and its non-empty interval, say real numbers larger than zero and smaller than one, so we will prove it.

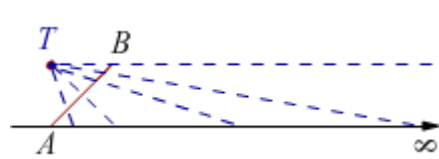
The cardinal number of a set of irrational numbers is equal to the cardinal number of sets of all real numbers and is equal to each non-empty interval of real numbers. This cardinal number is called a continuum and here⁶ is denoted by ∞ . In order to avoid the inventing of new terms, we also call the sets of real axis points as a continuum, not only because they have as real numbers, but also because it can be formally identified.

Using the method of contradiction, we prove that a set of real numbers, the interval from zero to one, is not countable. Suppose the contrary, that the set of all such numbers can be mapped into a sequence of numbers, and then note that for each number from the given interval there is a decimal format in the form $0, c_1 c_2 c_3 \dots$ where the letter c_n with indexes $n = 1, 2, 3, \dots$ represent the digit of that decimal numbers. So, $c_n \in \{0, 1, \dots, 9\}$. From this series we notice the first number and replace its first decimal digit by any other decimal digit $c_1 \rightarrow d_1$. Let's do it similarly with the second decimal digit $c_2 \rightarrow d_2$, then with the third $c_3 \rightarrow d_3$ and so on, $c_n \rightarrow d_n$, where it is $c_n \neq d_n$ for each individual $n = 1, 2, 3, \dots$. We've got a real number that's also from zero to one. However, it is not anyone of the numbers in the given series!

Namely, the new number belongs to the same interval $r \in (0, 1)$, but it differs from the first number of the given series on the first decimal, from the second it differs in the second decimals, from the third to the third, and so on, from the n -th number of the given series is different from n -th decimals. This is a contradiction with the assumption that all real numbers of a given interval are in the set. Therefore, the assumption is incorrect, i.e. it is true that these real numbers cannot be aligned into one (infinite) series.

In other words, the set of real numbers of interval from zero to one is uncountable infinite, especially

the set of all real numbers is uncountable infinite. Further, using the picture on the left, we prove that there is a bijection of points of the segment AB and the semi-straight line $A\infty$ from the point T . If AB is the unit length interval of real numbers and this half-line the half-axis of real numbers, then it the continuum is the cardinal number of both sets. In particular, this means that no more than countable infinitely many continuums again give the continuum of the elements, and that the two semi-lines (the number axes) also have a continuum of points.



This is only part of a well-known mathematical story of infinities, for us more than sufficient to start. It can be shown that there are infinitely many cardinal numbers that we will not deal with, and that some of them are optional. It can be introduced as an axiom that there is a cardinal number between the aleph zero and the continuum, or that it does not exist, and we will nevertheless get a not contradictory

⁶ Precisely, c – continuum.

theory (of sets). This is because there are independent abstracted truths that can be supplemented by independent axioms and get more detailed theories.

Gödel's incompleteness theorem speaks of this. No mind how many new truths we add to the theory as independent axioms, there will always be truths that are provable, but not from the theorems of the theory. Although confusing this show and that the search for truth is much more complicated than we could ever guess, yet again, that they are available to us.

The reflection of these worlds of infinite truths is the material world. I do not intend to say Plato's world of ideas, because we are talking only of those parts that are true statements. Secondly, there is no set of all sets (Russell's paradox), so there is no point in talking about a world of truth that contains everything, as there is no point in talking about the theory of all theories (Gödel's theorem) or, say, the formula of all formulas. There are so many exact statements. Since we mean that the material world must also be constructed as accurate statements, it now imposes an important question: why are physical properties always in final gatherings?

It is obvious that all material properties are some final sets. We do not usually discuss this, but we accept it tacitly, as well as the assumption that natural sciences seek the knowledge that is true. We then consider science to be exact if we consider the term "exact" to be equivalent to the "true statement" of mathematics. Therefore, the previously asked question is: Is there any logical connection between the mathematics of infinity and the exact doctrines of the material consequence of which they are reduced to the very final multitudes? Of course it exists.

When we divide a set of integers into positive and negative, we get two sets of both cardinal numbers equal to the cardinal number of the initial unit. It is a common feature of all infinities: you can even divide them into infinitely many (different) parts, and in each part you get as many elements as they were in the whole. Mathematicians played a lot with such divisions. For example, the division of the body into just a few sets with so-called infinite sets of points was discovered that, without changing the mutual distance of points within separate sets, the rigid displacement can conclude two bodies exactly equal to the initial. Transferred this into the world of physical substances, similar disintegration and assembling, come in contradiction with the laws of conservancies⁷, which means that in the material world there are no infinite sets.

Banach–Tarski paradox is a theorem of the theory of sets and geometries which states: "If an arbitrary ball is given in a three-dimensional space then there is an separation (decomposition) of the ball to the final number of disjunctive (no common points) sets, from which can be assembled two identical copies of the original ball". Assembly is a process that involves only moving parts as well as rotating them, without changing their shape. However, the parts themselves are not "geometric bodies" in the usual sense, but infinite dispersion (scattering) of points. Reconstruction can work and with only five parts (see [7]).

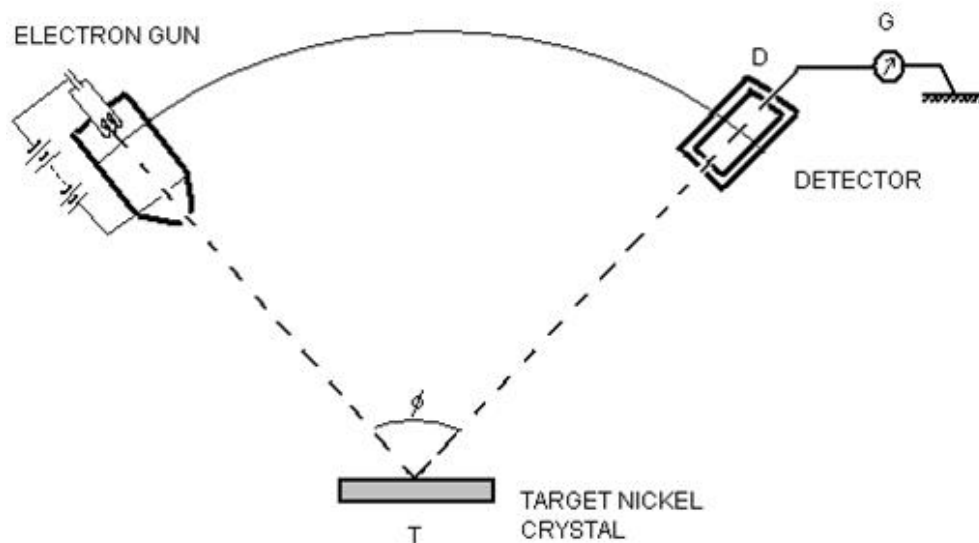
⁷ Energy cannot appear from nothing or disappear into nothing, but can only be transformed from one form to another. Similarly applies to the mass, momentum, spin.

Uncertainty

The principle of the finiteness of matter, which we just identified, says that each material property is final. For matter there is no possibility of infinite divisions, so it is always atomized, quantized, quarked. However, in the background of these corpuscles, there is always an abstract world of truth, and they will have similar direct consequences in similar interrelations. Since the number of these corpuscles, relationships and consequences is always finite, the number of their combinations is final, so all material phenomena are sooner or later (approximately) periodic.

That's why material particles always have wavy nature. Photons (light particles), electrons (particles of negative electric charge), atoms, and even larger bodies, always have positive wavelengths, as lesser as their mass and speed are larger. This can be proved precisely by the development of an arbitrary function of the material property in the Fourier series of trigonometric functions, when this property becomes periodic, since the conditions for this development are always satisfied due the principle of finality. The experimental evidence of this claim is found in physics with one by one type of particles.

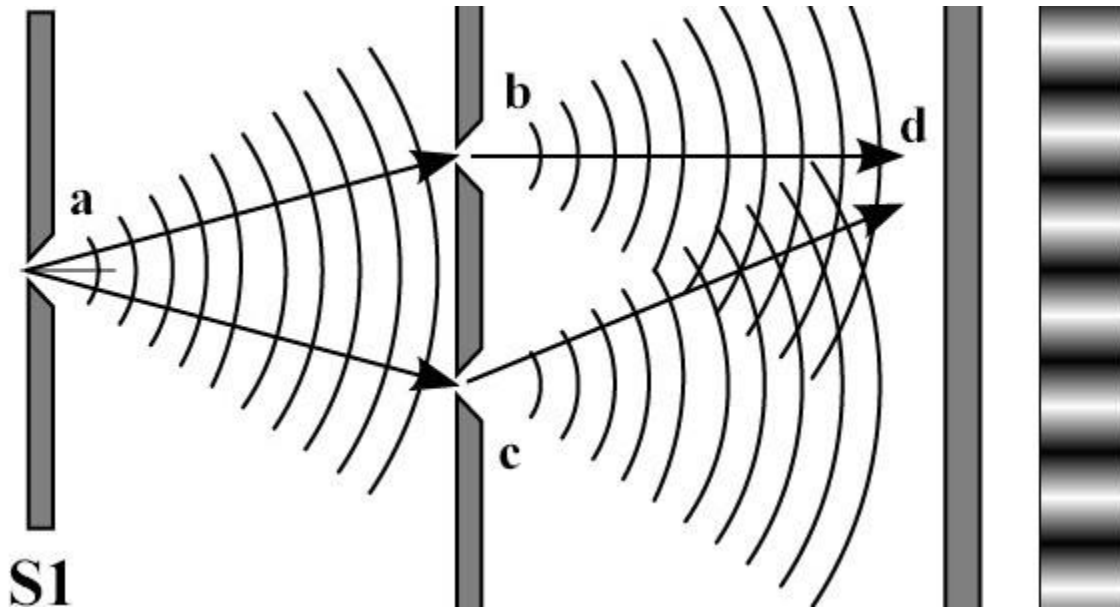
The electromagnetic radiation corpses are photons, but these radiations and transversal waves (which oscillate perpendicular to the direction of motion) of different wavelengths. Usually, the part of that spectrum that we observe with the sight of the eye is called light. The first experimental evidence of the wave nature of light was by diffraction (spreading through the opening or around the obstacle) and by interference (by increasing or decreasing the observed strength). All electromagnetic waves can travel by vacuum, and their transversal nature is proven by polarization (weakening by passing through the grid).



The picture is a schematic of the Davisson–Germer experiment from 1932-1937, which proved the wave nature of the electron. The electrons thrown out of the "gun" hit the "target" T of the nickel crystal, reflecting and scattering at different angles ϕ , which the detector catches. This was also one of the first evidence of Louis de Broglie hypothesis of 1924 on the wave-particle duality, and then the cornerstone of quantum mechanics.

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The second method of experimental evidence of the wave nature of particles is the famous "double slit" experiment, shown in the following figure. On the panel S1 there is a source of waves (photons, electrons) that arrives to another plate with two narrow slits **b** and **c**, behind which they spread and interfere. The third panel is a detector **d**. It accumulates the incoming energy of radiation and after a long time shows the straps of weaker and stronger intensities. The intensity distribution corresponds to wave interferences and is not explained by the particles themselves.



Physics enters the scene. Louis de Broglie (hypo) thesis about the wave-particle properties of light and electric current has long been regarded as proven. He determined that the product of the wavelength (λ – the length of one oscillation along the direction of motion) and the momentum ($p = mv$ – the product of mass and velocity) is equal to the Planck constant ($\lambda p = h$), so small that the wavelength of the massive and faster bodies is negligible and practically impossible to measure. Therefore, his thesis has more theoretical significance, but for now it fits perfectly into the wider picture of quantum physics.

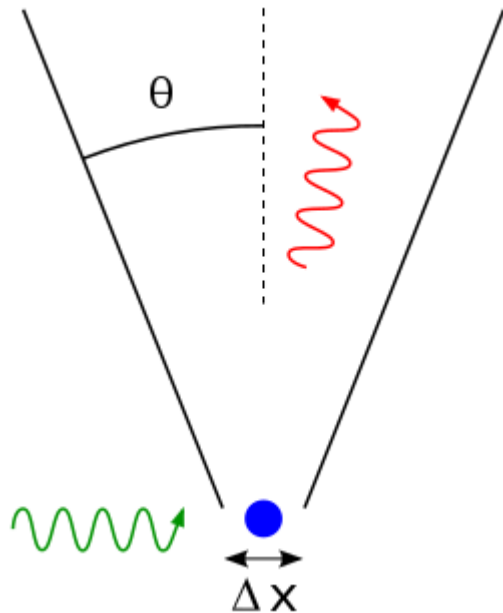
When there is no straight line motion, the particles do not stand still, but oscillate in place within their wavelength. The duration of one oscillation (τ) is reciprocal to the frequency ($f = 1/\tau$), the number of oscillations in the unit of time, and for the velocity of the wave, the length passed for the given time, we again take the quotient of the length of one oscillation and the duration of this oscillation ($v = \lambda/\tau$). As in the state of oscillation around a single location, so in the case of straight line motion, wave velocity is a product of wavelength and frequency ($v = \lambda f$).

Energy is the sum of potential and kinetic energy ($E = E_p + E_k$). The kinetic energy is proportional to the particle mass and the square of the speed (more precisely $E_k = mv^2/2$), and in the case of the mentioned oscillation it can be assumed that it is approximately equal to the potential, and from de Broglie's hypothesis it follows that the observed energy of the particle is inversely proportional to the duration of the observation ($E\tau = h$).

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In short, this is a sketch of the consistency of de Broglie's discovery of the dual nature of the wave-particles and the discovery of quantum mechanics that subsequently followed. The higher the wavelength of the particle, the smaller the momentum is. Wavelengths make up the places by which the particle is "smeared" at a given moment, so the product of the uncertainty of the position of the particle and its momentum is constant. Consistent, the product of the uncertainty of the energy of the particle and the time of its observation is equal to the same constant. These were Heisenberg's uncertainty relations of indeterminacy discovered in 1925, that is, just one year after Louis de Broglie hypothesis.

The confirmation of the same can be seen on the drawing of the Heisenberg microscope on the left.



Photon is shooting the electron along abscissa (x -axis). The shorter wavelength (λ) of photons, the measured position of the affected electrons will have lower uncertainty ($\lambda \approx \Delta x$). But then there is a greater uncertainty of the exchanged photons and electrons momentums ($\Delta p \Delta x \approx h$), so the more indeterminate is the momentum of the electron itself.

By means of the discoveries of quantum mechanics, a theory of theoretical physics was developed for the confirmation of Heisenberg's relations, so they became the "uncertainty principle", always related to the product of the uncertainty of position and momentum, that is, time and energy. But I'm a mathematician, so I had to ask for confirmation (or disputes) on the other side.

For example, at the beginning of this section it states that every function, in the conditions of matter, can be represented in the Fourier series by the sum of (interference) sinusoids. From this we have drawn the conclusion about the duality of wave-particles, which I consider as important as the de Broglie hypothesis itself and its later experimental evidence. However, each function can also be developed in the same conditions in the series of polynomials (Taylor), as well as in different fragments of various functions of mathematics.

The lesson is that there is no specific waveform sinusoid of the wave-particles. Louis de Broglie waves are indefinite scattering of particles by the positions of the given wavelength! Also, these are indefinite particle appearances during the duration of the given oscillation. So, we can only talk about the probabilities of our observation of a particle and, possibly, the observation of the outer world by a particle. The first one corresponds to the well-known Born's law, which says that the square of the oscillation amplitude represents the probability of finding the wave-particles at a given site by measurement. The second probability is less relevant to quantum physics: the wavelength decrease with the chance that the motion of the wave-particles occurs in the direction.

Both probabilities, derived from amplitude and wavelength, are important for understanding the events in the micro-world, and then in the macro-world of physics. The first is today the central place of classical quantum mechanics, and we associate the other with de Broglie's hypothesis.

Freedom

Because the direction of movement, velocity, and momentum vectors, Heisenberg's uncertainty relation speak about indetermination of position and momentum along some direction. The same is the wavelength and waves momentum. In both interpretations, the product of the two is constant. This should not be confused with the uncertainty of position along one axis of movement and momentum along the other, which are of independent size. In order to exhaust this topic, even in a wider comprehensible way, one should notice the formal connection between Heisenberg's⁸ uncertainty of the inanimate with the animate world.

The total perceptions of the living being, acquired through the senses and the intellect, are dedicated to the freedoms of individuals and their work within the social organization to which they belong. Ants and grass do not have the same perception of the soil they are on. They can therefore be in a complementary relationship. Ants and ants (different colonies) may be in conflict just because they have similar perceptions, which have the same (similar) right to resources, because they are equal. So, equality within the same perceptions generates conflicts. This is an important and unexpected conclusion of the book "Information of Perception" [3]. But we'll talk about it later.



The freedom of a living being is the amount of disposal options. Roughly speaking, freedom is some kind of information, or amount of uncertainty. Continuation of the known definitions. Before we throw a fair coin, the amount of the uncertainty is exactly the same as the information obtained after throwing the coin (logarithm of number two). Before we throw a fair dice (cube), we have uncertainties, the quantities exactly identical to the information we get with the throwout result (logarithm of number six). If we consider the uncertainty with the type of information, we will simplify the law of conserving

⁸ Werner Heisenberg (1901-1976), German theoretical physicist.

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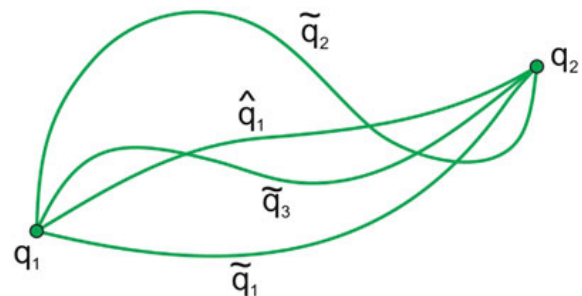
physical information: information can neither appear from nothing nor disappear into nothing, but can only be transformed from one form to another⁹.

If the information we produced could just disappear, we would not be able to rely on experimental evidence at all. If it can be returned to uncertain states, say by interaction of particles, then it will not be in conflict with the previous determinant of information, nor with the law of conservation. Also, the extraction of information part by part from the perchances will be in accordance with this law. Information gathering is equivalent to the realization of various random events. The outcomes of throwing (fair) coin and cube are 12 equal pairs of events whose information is equal to the sum of the information of the coin itself and the cube itself ($\log 12 = \log 2 + \log 6$). Therefore, information is the value we can measure, such as mass, consumed electricity, water. Hartley¹⁰ hoped for this disavering the information.

By linking it to free will, we see the information as something realistic, physically. Even before this discovery, we did not doubt that organizations that limit free will are real, but now we can conclude that it is important to define the freedom of an individual as its ability to use the given options, and the ability of the environment to deny these options to it. I called the first of these abilities the "intelligence" of the individual, the other "hierarchy" of the environment¹¹. It is shown that both vectors are coupled with the corresponding components.

Analytically speaking, broken down into appropriate components, freedom and non-freedom come in pairs. In each pair there is one component of intelligence, the ability to use the given option, multiplied by the appropriate component of the hierarchy, the ability of the environment to limit this option. The sum of these products is the information of perception, freedom or vitality.

For example, the decision to cross over Rubicon is on contrary to the law of the Senate. Precisely because these values are opposed, the will of Caesar to the ban of the Senate, each of them increases the value of vitality, gives greater value to the character of Caesar. If we understood that he was a strong personality because he bravely obstructed the obstacles, then the conclusion is drawn that the person who is waiving of the conflicts is out of the way, restricted, in the sense that he has a smaller amount of these freedoms, has less vitality.



In the extreme case, when more in one means less of the other, in relation to the given option, when a "person" is left as a leaves down the water avoiding the ban, we get Heisenberg's relations of uncertainty. Unlike living beings that defy bans, the principle of the least action, long known to theoretical physics, applies to non-living beings. In the above figure on the right we see different paths from q_1 to q_2 , but only those path \hat{q}_1 with the least energy consumption will be physically realized, the least route, the least time consuming. For example, the light is reflected

⁹ Similar to the energy.

¹⁰ Ralph Hartley (1888-1970), American electronics engineer.

¹¹ In the book [3].

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from the mirror crossing from the first to the second point in the shortest path, for the shortest time, with the same incident and reflected angles, without the change of energy.

Therefore, the living being has more information than the corresponding non-living being. It is similar to energy, where the surplus energy enters into the maintenance of more body temperature, internal body functions and movement. This surplus of energy is obtained by feeding, as well as excessive information, I suppose.

We define freedom with the formula $S = a_1b_1 + a_2b_2 + \dots + a_nb_n$ that is a scalar product of a vector with components a_k and vector with components b_k . This is the expression known from the algebra vector space and, therefore, is non-contradictory. When a -s are probability, and the corresponding factors (b -s) are the logarithms of the probability, then we get in the mathematics known Shannon's information. Accordingly, the freedom is generalised information.

When we multiply pairs of the same sets of differently ordered, we get different results:

$$46 = 3 \cdot 7 + 2 \cdot 8 + 1 \cdot 9 < 1 \cdot 7 + 2 \cdot 8 + 3 \cdot 9 = 50$$

If the upper ones, the components of a are paired with components of b so that with larger goes smaller and with a smaller one the larger, then we get the Heisenberg's relations of uncertainty (in several dimensions), that is, the principle of the least effect. Then, we get the minimum value for the expression. The maximum value, when multiplying the same arrays, is obtained when we redistribute the numbers so that the larger coefficient is multiplied by the larger and vice versa, the smaller with smaller. To this result goes the freedom of a living being. Due to the excess of freedom, a living being can leave the path with the least energy consumption.

We said that in the formula of freedom, the coefficients of b represent limitations due to the hierarchy. If some of these coefficients were zero, that summand would disappear, and we would say that this property is unorganized, it is in total disarray. However, there is no zero hierarchy! Every physical body, and therefore every living entity, is primarily limited by some physical laws, and any attempt to make an "absolute mess" will end in some order. It is not only some dubious obviousness taken from speculative physics, but also the content of Ramsey Theory. Paraphrasing: randomly sticking words in a book, sooner or later, must result in some meaningful sentence. Also, in random cloud schedules in the sky, we can always "see" some famous character if we are looking for enough.

This is in accordance with the principle of the finiteness of matter. We see this when we look at the links of the causal chain of events. In an abstract world of truth, a series of causes-consequences can be infinite, which in the case of a physical substance is not possible. Then infinite series of causes must be organized into finite units, such as droplets of water held together by cohesion and other forces, which can collapse into larger similar in collision, or split into smaller ones. The interior of the structure of these smallest parts of the external world of matter is completely inaccessible. Hence, the coincidence, probability and information inherent in the material world and in it are objective, so Caesar could throw a dice and remove the responsibility in case of the outcome of the Rubicon crossing.

Multiverse

What happens when we throw a coin and promise that in the event of a fall of the "head" we will stay in the room, and in the fall of the "tail" we go into the hallway? We submit our will to the outcome of objective uncertainty, and then, for example, the "head". If we could know what would happen, then the coincidence would not be objective. If the "head" both, fall and do not fall, then we would have a logical contradiction (from the truth, two opposite consequences), that is, we would find ourselves in the room and in the corridor, and we would notice a violation of physical laws of maintenance (information, energy, ...). Our consciousness can, but also has to choose.

Disputing the "head" event after throwing coins and dropping a "tail" is just a challenge to the objectivity of coincidence. If my "I" is the witness of the outcome "tail", then there is also my pseudo-"I" who is the witness of the outcome "head". In both parallel realities, in two different outcomes of falling coins, the same laws of physics apply. This is the first thing that makes this idea of a multiverse different from all of the previous ones. I will not list them all.

Recall that the idea of multiverse is not new. It is known to us from ancient Greek mythology, to contemporary quantum mechanics, in various forms.



temporary quantum mechanics, in various forms. In his book *Optics* (1704), Newton¹² suggested a similar idea, which, unlike this, would tolerate different laws of physics in various parallel realities. I quote a translation:

"And since the space is divided in infinite, and matter is not necessary in all places, it is possible to imagine that God created particles of matter of several sizes and images and in several proportions in space, and perhaps different intensities and forces, and therefore that he varied the laws of nature and made worlds of different types in several parts of the universe. For now, I do not see anything contradictory in all this."

American philosopher William James used the term "multiverse" in 1895, in a different context. Schrödinger¹³ held a lecture in Dublin in 1952, in which the audience warned him that what he says "looks crazy". And he talked about equations that describe different histories, not "alternative", but the real ones that would happen at the same time.

We can use the same terminology for real and pseudo-real, previously defined on interactions, and now based on the exchange of physical information. My pseudo-"I" went into a parallel reality, which was then a pseudo-reality for me, because communication with such would mean breaking the law of conservation, not to mention the contradiction. Pseudo-information would come to the knowledge of, for example, the Pythagorean theorem, which we can use, and then because of it to change our material world, but without changing the theorem itself.

¹² Isaac Newton (1643-1727), English mathematician.

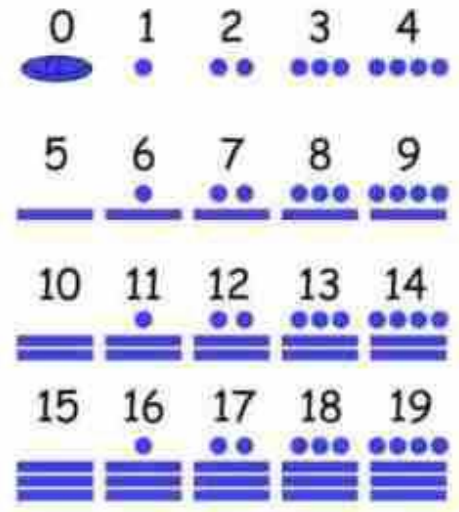
¹³ Erwin Schrödinger (1887-1961), Austrian physicist.

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In doing so, it is important to note that there is no actual communication between the observers whose time would possibly go in different directions. Namely, before a question arises, such an observer will have to give an answer, and this is not real because of objective unpredictability. However, some blunt reactions are possible, kicking on the first ball, when you do not have to anticipate the consequences. This means that the particles with the opposite time flow are not impossible, and if they exist (for example, matter and antimatter), then elementary particles are elementary and in terms of information they can exchange.

According to the principle of the finiteness of matter, in each of the parallel realities there cannot be more than countless infinitely many neither the observers (particles) nor what they can perceive. In the same way, the time series of events is also limited. Let us show now that therefore can not be more than a continuum of many parallel realities.

Let's assume that at each moment there are only two random outcome options. In any of the parallel realities we follow this as a series of events "I will stay" and "I will not stay" on that line. The first option is to join 1, the other 0, and write down the number $B = 0, b_1 b_2 b_3 \dots$ that is the sequence where all the binary digits are possible on at most countable infinitely many places behind the comma. It is a real-number binary, which can be any one from zero to one. Such are the continuum many.



We would also get the same if we consider at any moment we not two, but $n = 2, 3, 4, \dots$ opportunities.

Then the number again would be a real number B in the interval from zero to one, but recorded as a number in base n . It does not matter in which numerical system

we are writing, the amount of numbers in the given interval is always the same. On the picture on the right is the numerous system of Maya, which, even if it is written more complex, always expresses the same sizes.

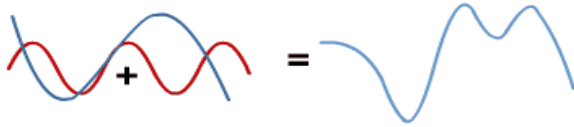
This is a brief explanation of the evidence that parallel realities has a continuum much, assuming that the events have countness infinitely many. And in order for our time to be considered as explainable to countness infinitely many events, we see in the following way. Each division into elemental time intervals is equally possible. It depends only on the viewpoint of the selected observer. As we can not determine a number in a set of natural numbers as larger than all others, so we can not even choose a sufficiently small time interval that would be shorter than all the others. Until official physics adopts a time atom unique to all observers, the cardinal number of all events of the universe is \aleph_0 , and ∞ the cardinal number of all parallel realities.

The continuum of parallel universes explains why quantum mechanics is based on Hilbert's space. It is "everywhere dense" vector space, professionally said "in which every Cauchy sequence converges". You do not need to understand what this is about, except that some things have now allocated into its place.

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Different physical properties, such as mass, temperature, position, measured by different physical dimensions (kilogram, degree Celsius, meter), are representations of different vectors. They define the quantum state in a given situation represented by physical characteristics interesting for the case we are studying. An example of this is the hydrogen atom, with the observables (values to be measured) represented by the base vectors. Some other vectors of this vector space are representations of particular states in which the system could be found. Measurable sizes always have lot, but the vector space that they span (spread) is Hilbert, which means a continuum.

The quantum superposition presented in the figure on the left is the basic principle of quantum mechanics. It is claimed, like the waves of classical physics, that every two (or more) quantum states can be added together (superpose), and the result will be another correct quantum state; and vice versa, any quantum state can be represented as a sum of two or more other different states. This completely corresponds to the addition of the mentioned vectors; and vice versa, the possibility of a unique decomposition of each vector into vectors of an arbitrary base.



The action of a linear operator on a vector represents the "evolution" of the quantum state, as we call that change. The process of measurement is the projection of the state to one of the axes (observables), which we call "collapse" of the superposition into one of the outcomes. This is similar to throwing a coin, for example when a "head" falls, and the "tail" result goes to another parallel reality. These two of our accomplishments, for returnees, backward travelers in time, represent a superposition for which one of the uncertainties of our past is an accomplished outcome. The mathematics of quantum mechanics supports this explanation, since every quantum operator is invertable. This is an important conclusion from the book "Quantum Mechanics" [1], which justifies the idea of the multiverse described here, and that is why I refer to it without the intention to deal with proofs now.

According to this hypothesis of the multiverse, arising from the above assumptions that we have choices, each person practically chooses his multiverse. It turns out that every individual chooses its future, as well as its environment, in a small, negligible scope and the shape of its own space to which it belongs. We can also say this on the next way. By making its decisions, every living being (defined by the decision-making power) is the creator of the universe. Accordingly, the answer to the main question of this section will be that the supreme will of decision-making, not just about its own life, but also about other living beings around, and also about the non-living environment, is each one single living entity. This is not in contradiction with the previous thesis that Caesar, senators, and the legal system of Rome, are also the supreme will. They are supreme authorities for the lives of others from the "outside" and to a lesser or greater extent, while certain individuals on the same reality can act "from within".

Predestination

It is easy to confuse the Greek god of time, Chronos (Χρόνος), with Zeus' Titan father, Kronos (Κρόνος). Anyway, we will say that in ancient Greek mythology Kronos was the youngest son of Uranus and Gaia. He cast his father by castrating him and ruled by the so-called "golden age" until his sons Hades, Poseidon and Zeus, who had captured him in Tartarus, defeated him. Brothers Hades, Poseidon and Zeus pulled a draw and Hades pulled out to rule underground, Poseidon by the sea, and Zeus to heaven and other gods.



Chronos is the primordial deity (first generation), the God of Time, the God of creation. The Old Greeks imagined him with a snake body with three heads – a man, a bull and a lion, and in Greek-Roman mosaics he is usually portrayed as Eon, an enchanted eternity, often misunderstood as Kronos. It stands before the sky and holds the wheel on which the zodiac signs are printed. Underneath it was usually Gaia (Mother Earth). Non described him as a wise old man with long, gray hair and beard. Mosaics, however, display a young figure. Some words in European languages were derived from the word Chron: chronology, chronometer, chronicle, chronic, anachronism, chronophobia, chronography, chronostratigraphy.

The ancient Greek gods are not as powerful as some of the later, but are immortal, so Kronos could not prevent the growing up and strengthening of his children who eventually came to his head. The limitation of the power of Greek gods is also seen in the consent of his sons to decide coincidence on the division of the future government. According to Greek tradition, the eldest son Hades had the right to choose the first and get the highest, but the strongest Zeus succeeded in replacing it with the cube, pointing out coincidence as the most objective way of choosing. Zeus thus gained heaven and became the supreme deity, and Hades, the three of them, passed the worst, having got the dead.

The Greeks believed that the mortals could be controlled by the immortals, but they were not completely sure of the true nature of the fate while they were left suspicious that Zeus may have manipulated. In many later religions we find similar dilemmas. Even in the Bible, in a seemingly conflicting, God has a plan for us, while as human beings we have the free will to choose ours way.

Namely, in the chapter "Jeremiah 29:11" is the plan. For I know the plans I have for you – the Lord's statement – plans to prosper you and not to harm you, plans to give you hope and a future. Many chapters of the Bible write about free will, but the most commonly quoted is "Micah 6: 8" where it says: "He has shown you, O mortal, what is good. And what does the Lord require of you? To act justly and to love mercy and to walk humbly with your God."

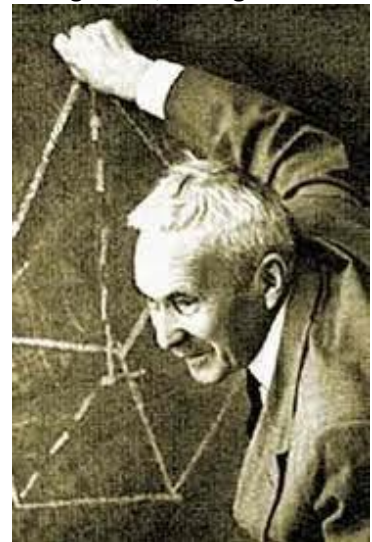
How difficult the question, necessity or free will, it is seen in its general significance, and, on the other hand, in the inability of mathematics to find the answer on it.

Probability

How do we know that most likely happens most often? Well, we actually do not know, until we define probability. But then it becomes a strange feature of the sentence that it is possible to align it with some measurements, which this allegation can become the universal principle of probability.

The probability is a real number from zero to one. The probability function, usually denoted by $P(\omega)$, maps a random event ω , from a set Ω of all possible random events of a given task, into a set of real numbers of intervals (0,1). Impossible event has zero probability, a certain event has probability one. An impossible event is an empty set \emptyset , and a certain event is a complete set Ω . Each event is a subset of the certain event. The probability of a union of events without common elements is the sum of the probability of individual subsets.

Thus begins the formalism of the mathematical probability theory set by Kolmogorov¹⁴, the figure on the right, at the beginning of the 20th century, after which this theory no longer has to (and must not) rely on evidence by physical measurement, substance, or be evaluated with natural sciences. On the other hand, it has the reliability that it is not possible to find such a behavior of matter that would be inconsistent with the theorem of this old new theory.



A few centuries ago the construction of the naive probability theory began. It has been built by the greatest minds of their time, but rarely anyone believed in some great accuracy of what the nebulosus were doing. However, among the builders there were also mathematicians, and perhaps the first among them was Cardano who wrote the book of cube games (*Liber de ludo aleae*) and systematically processed the probability of events in those games, a century before Pascal and Fermat. Otherwise, Cardano is more famous for the solution of the cubic equation (*Ars magna*, 1545), which he inherited from Venetian mathematician Tartaglia.

Blaise Pascal¹⁵, the mathematical wonder of a child, later based his theory of probability in his famous five letters, four of which have been preserved to date. By reading them, you will notice many computational errors, which Pascal seemed to have not noticed as he extracted genius conclusions from the solution of his tasks. He corresponded with Fermat¹⁶, whom we often call the founder of number theory, who, together with Descartes, discovered the basic principle of analytic geometry. Due to the discovery of the method for finding the tangent to the curve and the points of minimum and maximum, we consider him as one of the founders of differential calculus. Through the correspondence and discussion with Pascal, he is co-founder of the theory of probability. The gathering place of mathematicians and physicists around Pascal today is the French Academy of Sciences.

¹⁴ Andrey Kolmogorov (1903-1987), Russian mathematician.

¹⁵ Blaise Pascal (1623-1662), French mathematician, physicist and philosopher.

¹⁶ Pierre de Fermat (1601-1665), French mathematician and lawyer.

To Kolmogorov, Jacob Bernoulli¹⁷ gave significant contributions to the theory of probability. Among other things, he proved a special case of large-number law and constructed a model for describing a series of independent experiments, the so-call Bernoulli's, or a binomial, scheme. Many members of the Bernoulli family have been engaged in mathematics and should be distinguished from this one which was among the first, the oldest of them. Moivre¹⁸ is an English mathematician born in France. In the theory of probability, he introduced a random event. Laplace¹⁹ developed and systematized the results of his predecessors, proved Moivre-Laplace theorem and introduced the concept of mathematical expectations. They were followed by Gauss, Poison, Chebyshev and Markov with very significant contributions to probability theory, which are too complicated for this kind of review.

The throwing of a fair coin has two equally likely outcomes, each with a probability of 0.5. When a set



Ω represents only one throw, the only events are the "tail" and "head", which we mark shorter with T and H. Then $p(T) = p(H) = 0.5$. When a certain event, a set Ω , represents two throws, there are four equal events: TT, TH, HT and HH. The probability of each is 0.25. If the certain event, the universal set Ω , represents three throws, then there are $2^3 = 8$ equal outcomes: TTT, TTH, THT, HTT, THH, HTH, HHT, HHH, each probability 0,125. By continuing we can develop the probability theory.

It goes like this, seemingly simple, so that only later on we can notice that things with odds are not completely confused as we initially expected. Let's look at, for example, what is the probability of throwing a coin until the "tail" falls for the first time. Possible event is T, but also HT, then HHT, and HHHT, and so on indefinitely, because it is theoretically possible to throw a coin and to constantly and constantly fall "head". The certain event, the universal set then is

$$\Omega = \{H, HT, HHT, HHHT, \dots\}$$

with probabilities:

$$P(H) = \frac{1}{2}, \quad P(HT) = \frac{1}{4}, \quad P(HHT) = \frac{1}{8}, \quad P(HHHT) = \frac{1}{16}, \quad \dots$$

whose infinite sum will really be getting closer to the unit when we take more and more summands in a row. When we note that obtaining a "tail" in the second throw is not the same as obtaining a "tail" in the third throw, we would be able, based on these probabilities, to make a pure algebraic claim that

$$\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \dots = 1$$

¹⁷ Jacob Bernoulli (1654-1705), Swiss mathematician.

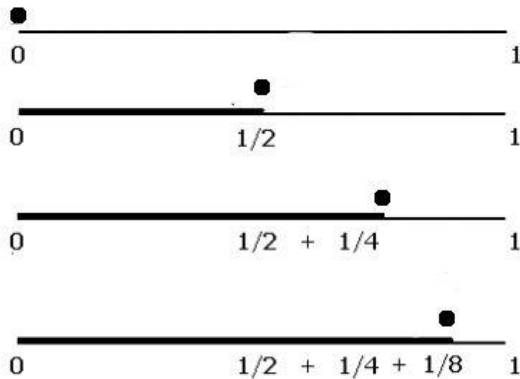
¹⁸ Abraham de Moivre (1667-1754), French mathematician.

¹⁹ Pierre-Simon Laplace (1749-1828), French scientist.

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which is, of course, true. Here's how we can prove the same as geometric item. Let's look at the next splitting of the smaller lengths.

In the figure on the left we see a unit length with a black dot moving from 0 to 1. It will first pass half



way and reach the real number $\frac{1}{2}$. Then it will cross half of the remaining road and reach $\frac{1}{2} + \frac{1}{4}$. Next, it will cross the next half and reach $\frac{1}{2} + \frac{1}{4} + \frac{1}{8}$, and here we recognize the previous algebraic formula. If the point runs towards the unit, it is clear that it will cross all the smaller ones soon reaching its goal through this "infinity".

Thus, starting from probability, exact views of algebra, geometry, or any other field of mathematics can be proven, because, because from the precise assumptions, something incorrect

cannot be obtained. When he gets something false, we said, the mathematician should not be confused, he only has to return to the assumption and to say: it is proof that this assumption is false!

I cite this example for some more interesting observations. One of them is Zeno's paradoxes with infinity. Let's say, Achilles races to catch a slower runner a tortoise that is crawling in a line away from him. The tortoise has a head start, so if Achilles hopes to overtake it, he must run at least as far as the place where the tortoise presently is, but by the time he arrives there, it will have crawled to a new place, so then Achilles must run at least to this new place, but the tortoise meanwhile will have crawled on, and so forth. Achilles will never catch the tortoise, says Zeno.

Zeno noticed that something was "wrong" with infinity, but that was insufficient to allow his contemporaries, ancient Greeks, to renounce the belief in the immortality of their gods. Moreover, they still believed in the superiority of infinity over finite things and remained on the belief that they were subordinates to immortal ones. Almost, we would say, they were on the right track.

The principle of probability, that more likely is more often, implies a growing law and causality when random events become massive. I recall that causality is an expression for the necessary connection between precedent and consequence. Whenever there is a consequence, there is a cause. It is the primary feature of infinity, and matter is infinity packed into final sets, so it is to be expected to express greater causality with greater mass.

Primary to the matter, the probability appears as "causality" around us. So I'm here where I am, not out there somewhere, because from my point of view this is most likely. The one is there because he is so more likely to him. The satellite moves in a gravitational field by the path that it sees as the most probable, and the body stays idle or uniformly in a straight line motion until another body or force is applied to it. The last sentence is well-known Newton's law of inertia that tells us now that force changes its probability.

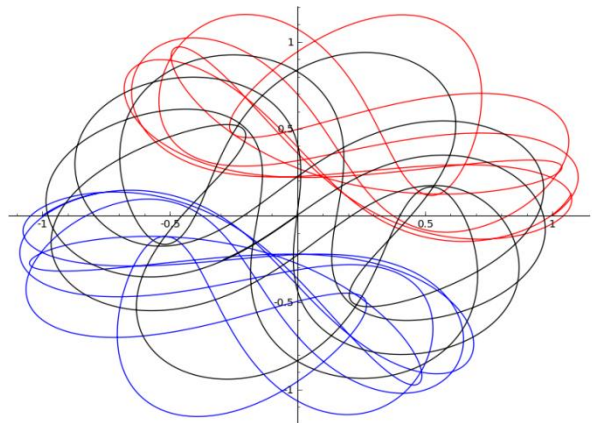
Chaos theory

Deterministic chaos theory is a new branch of mathematics. It studies the behavior of certain dynamic systems whose state evolves over time, which are very sensitive to initial conditions. It was mainly due to observation of unpredictable meteorological phenomena.

Inspired by the classic Newtonian mechanics, in 1814, in his philosophical essay on probability, Laplace wrote: "If we knew all the positions of all the particles at one time of the universe and all their speeds, we could calculate all their future positions. Anything that would happen later would be completely predictable for us." These Laplace words express the essence of mechanics that evolved into the leading physics ideology to the emergence of chaos theory and quantum mechanics. That is why the discovery of Chaos theory according to which small changes in initial conditions can cause great differences in the final results of any shock to the scientific community. This heavenly mechanism of Newton's mechanics could spoil even the smallest dust that would stuck somewhere in its wheels!

Suspensions of mechanics ideology also appeared before the new theories, within the framework of classical physics itself. Bernoulli used Newton's discoveries to carry out elliptical orbits of motion of pairs, the Moon around Earth with Earth in the focus, or Earth around the Sun with the Sun in the focus, ignoring the influence of the third planet. He obtained a satisfactory agreement with earlier Kepler²⁰ observations. However, although he was an outstanding mathematician, he failed to solve a similar problem for all three bodies: the Moon, the Earth, and the Sun. The problem of three bodies has become a special concern for astronomy. The philosophers' naturalists began to suspect that this was one more of the unsolvable integrals.

On the picture on the right there are three paths (black, blue and red) of bodies formed after several orbits, which shows why this problem was so difficult to solve. In the promotion of mathematics journal (*Acta Mathematica*), Leffler²¹ was granted the permission of King Oscar II of Sweden and Norway to run a mathematics contest. Several tasks have been announced (although the King preferred only one) for a 2500 kronas cash prize. Among those tasks was also the one who formulated Weierstrass²²: "Find the movement of the points of arbitrary masses that attract Newton's gravity, assuming that no two points ever collide." The prize was won by Poincaré²³. He showed that such a system does not exist.



Another problem that played an important role in the development of chaos dynamics was Boltzmann's²⁴ ergodic hypothesis. Boltzmann, like Maxwell²⁵, combined Newton's mechanics with the

²⁰ Johannes Kepler (1571-1630), German mathematician and astronomer.

²¹ Gösta Mittag-Leffler (1846-1927), Swedish mathematician.

²² Karl Weierstrass (1815-1897), German mathematician.

²³ Henri Poincaré (1854-1912), French mathematician.

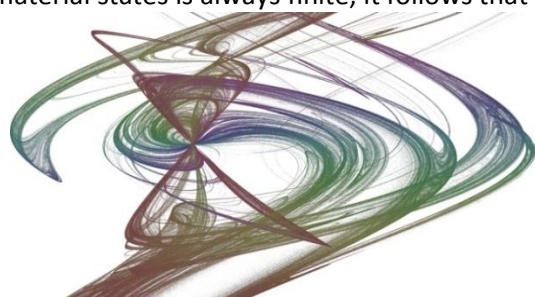
²⁴ Ludwig Boltzmann (1844-1906), an Austrian physicist and philosopher.

probability of obtaining statistical mechanics by performing thermodynamics from the equation of mechanics. To calculate the heat capacity, even the simplest system, Boltzmann had to make enormous simplifications and introduce the assumption of ergodicity: that over time, the dynamic system would pass through every possible condition allowed by maintenance laws.

In the theory of dynamic systems, for the precision of expression and use of mathematics, the phase space is defined. It is an abstract space in which any the possible states of the system as a point are presented, where each possible state corresponds to a unique position. In mechanics, this is usually the space of all possible position and momentum values. This concept became necessary for Boltzmann, Poincaré, and Gibbs²⁶ to study thermodynamics. The ergodic hypothesis thus says that in the long periods of time, the time that the system implements in the field of microstates of the phase space with the same energy is proportional to the volume of that area, i.e. that all accessible microstates are equally probable over a longer period of time.

Poincaré reorganized the ergodic hypothesis into the statement that the trajectory would pass arbitrarily close to any point in the phase space. This implies the physical continuity of the points, which is partly true because the material world is a part of the continuum. However, this somewhat draws this topic out of the point beyond the principle of the finiteness of matter. That is why I am making a brief break from the historical development of the chaos idea because of the following remark.

From the principle of finality, that any property of matter is finally, from where any part of the material world is finite, and so the number of combinations of material states is always finite, it follows that any material state will sooner or later begin to repeat itself. Small changes in initial conditions can produce great final differences, but nevertheless – the immediate consequences of similar conditions will yield similar outcomes.



The final conclusion is not a surprise, because we consider that the smallest particles of any property of the substance are close to the continuum of the world that is causative. This is confirmed by the discoveries of the attractors of deterministic chaos theory, on the picture on the right. These "weird" cyclical patterns are noticed by the long observation of chaotic events, surprising for such unpredictable phenomena. We will link these two explanations with the mentioned probability principle, although the official chaos theory is not stochastic.

I have already written that the body appears where it is because this position is most likely to it. Moreover, it will appear at the same point at the next moment if the influence of force on the probability of the environment does not change. That is why we have inertial rest or movement, because in the absence of force similar conditions produce similar direct consequences. And this will lead to the appearance of attractors and in the case of some future non-deterministic chaos theory.

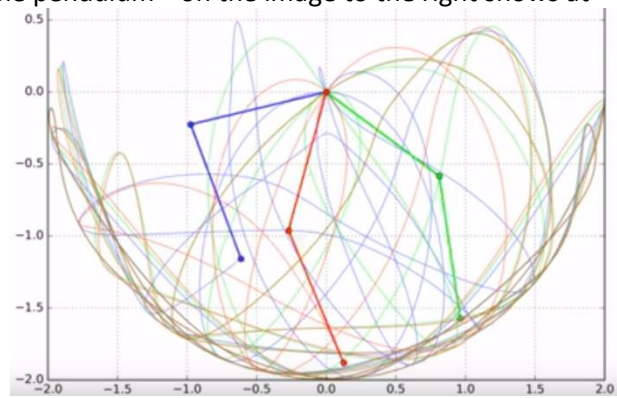
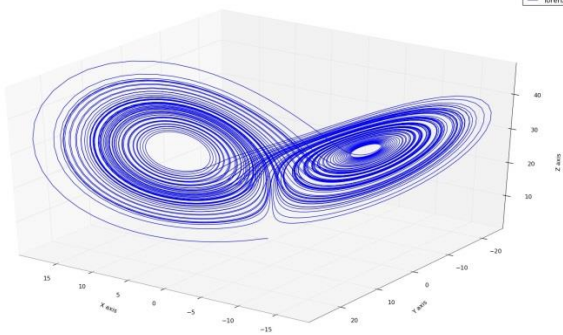
²⁵ James Clerk Maxwell (1831-1879), Scottish scientist.

²⁶ Josiah Willard Gibbs (1839-1903), American scientist.

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Demonstration of the chaotic movement of the double pendulum²⁷ on the image to the right shows at first the swinging of the three-ply twin pendulums (blue, red and green), three times two long, articulated and fixed at only one end point, which in time show more and more unpredictability in movement.

One of the founders of chaos theory, Lorenz²⁸, compared this unpredictability with the "butterfly effect". The wings of the butterflies in Brazil could be caused a hurricane in Texas, he said. He demonstrated this with a system of three simple differential equations (you can find them everywhere)



whose solutions are trajectories like shown in the picture on the left. The interesting thing of these equations is that the trajectories, even for the smallest changes of the initial conditions, are always different, but wherever in the form of a circulation that changes about two points, two attractors, as in the given figure. These figures are also called Lorenz's butterflies.

In 1975, Mandelbrot²⁹ then discovered fractals (lat. *fractus* – broken), geometric figures similar to their parts, each of which is (approximately) reduced the copy of the whole. These figures are like all smaller branches and branches that grow from a tree or mountain landscape like their less and less structure. Fractals similar to Lorenz's butterfly are obtained from simple formulas, by recursions (by inserting the entire function into its part).

The chaos theory was preceded by Rayleigh's³⁰ music research. In the first approximation, you can construct a model of a musical instrument as a linear oscillator, said Rayleigh, but the real instrument does not produce a tone forever, as does a linear oscillator. That is why he added the friction described in the book *The Theory of Sound* and obtained models of periodic movements of some systems that evolve seemingly independent of the initial conditions.

His works were later linked to the von Neumann³¹ and Birkhoff³² theorems on the ergodic hypothesis, published in 1912 and 1913. And these leads to Kolmogorov's concept of the entropy of dynamic systems with which, as a dynamic invariant, the classification of a set of abstract so called Bernoulli systems is possible. Here we will break this story, because it becomes too complicated for this level of consideration.

²⁷ Double Pendulum Chaos Demonstration: <https://www.youtube.com/watch?v=pEjZd-AvPco>

²⁸ Edward Norton Lorenz (1917-2008), American mathematician.

²⁹ Benoit Mandelbrot (1924-2010), Polish-French-American mathematician.

³⁰ Lord Rayleigh (1842-1919), English physicist.

³¹ John von Neumann (1903-1957), Hungarian-American mathematician.

³² George David Birkhoff (1884-1944), American mathematician.

Perception

An stimulant (distal object) is any kind of energy (mechanical, light, thermal, chemical) that stimulates the body's sensory organs and acts on the receptors and causes some change in the organism or its behavior. Threshold is the smallest amount of energy the receptor registers, and at the same time affects any change in the organism. The difference threshold is the smallest change in the irritation the organism is capable of perceiving. We follow the parts of the text from my book³³.

Energy obtained in the form of light from a distant star depends on the surface of the receiver and its distance to the star. The receiver can be a satellite antenna dish, a telescope lens, a camera, an eye. When the receiver does not change, the energy of the received light decreases with the square of the distance to the source. A similar thing happens with the sound that comes in the waves from the sound source to the ear or some other sound receivers. Touch observation happens through the skin, again with surface, as well as perceiving flavors or odors.

The organism is not absolutely sensitive to all energy intensities. Some lights are too weak to see, some sounds are too quiet to be heard, some touches are too light to feel. That value on the scale of the intensity of physical irritation at which observation begins is called the absolute threshold. We distinguish the lower and upper values of such thresholds. The threshold is not a sharp boundary, but a zone in which physical energies gradually change and have no effect, over those having a partial effect, to those with a full effect. For the absolute threshold, the values are observed in half of the cases were used, and now 75% of the correct answers are taken.

Weber³⁴ is one of the first researchers to study the human response to physical stimulus in a quantity



way. From 1834, he noticed that the differential threshold ΔW was irritating with the energy W already given. For example, if we hold a stone of $W = 50$ grams in the hand and we need at least $\Delta W = 1$ gram to notice the difference in weight, then for a stone of 100 grams the differential threshold is 2 grams.

From Weber, approximate, proportion

$$\Delta W : W = \text{const.}$$

it follows, also approximate, that the perception is proportional to the logarithm of the energy (energy

W). These results were modeled and published by Weber's student Fechner³⁵ in 1860.

Weber coefficient that's for load lifting 1:50, for pressure (touch on the skin) is 1: 7, for heat on the skin 1:30, for vision 1:60, for noise 1:10, for smell (tires) 1: 4, and for taste (kitchen salt) 1: 3. Summing (integrating) changes, we get the sum of all observations that the given sense can have, which is exactly the Fechner logarithm $H = k \cdot \ln W$, where the constant k depends on the basis of the logarithm and

³³ see [4]

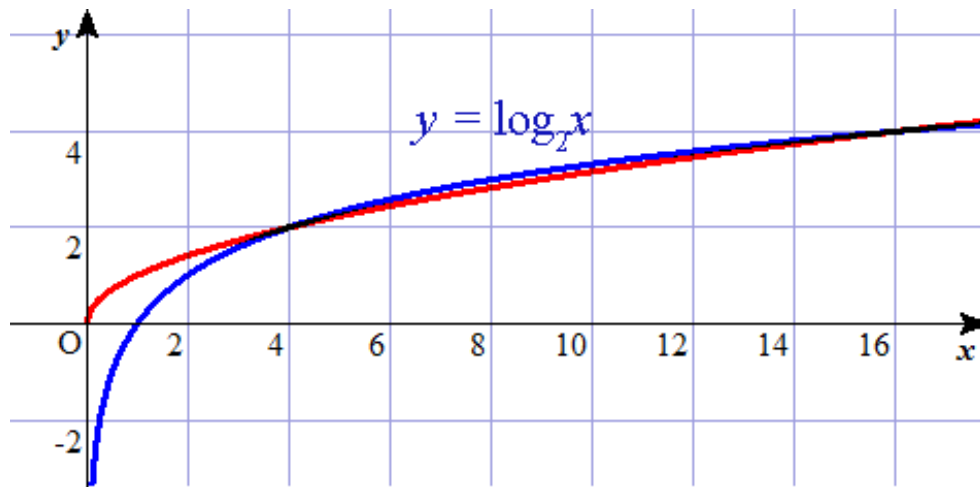
³⁴ Ernst Heinrich Weber (1795-1878), German doctor.

³⁵ Gustav Fechner (1801-1887), German philosopher and physician.

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the perceptual ability of the respondents, and the result I marked with H , because it represents well the overall information in the sense of Hartley's definition.

In 1928, Hartley found a definition of information working in Bell Telephone Company. Its definition, that the information of equally-probable random events is proportional to the logarithm of the number of outcomes, proved to be a worthwhile goal. Namely, a greater uncertainty we have expected outcome of the (fair) dice of six outcomes then before throwing coin with only two outcomes. The greater the number of equally probable possibilities $n = 2, 3, 4, \dots$ the greater the uncertainty before the realization of the random event, and that is why the higher information is obtained after, which according to Hartley is $\ln n$ written using the natural logarithm. Realization consumes uncertainty and information arises in terms of the amount equal to the uncertainties involved.



In the picture, a blue line is the graph of the logarithm of the base two. When abscissa represents the number of equally verified outcomes, then the ordinate represents information in bits. We will understand this by binary search, asking questions that are answered with "yes" or "no". The number of questions is information.

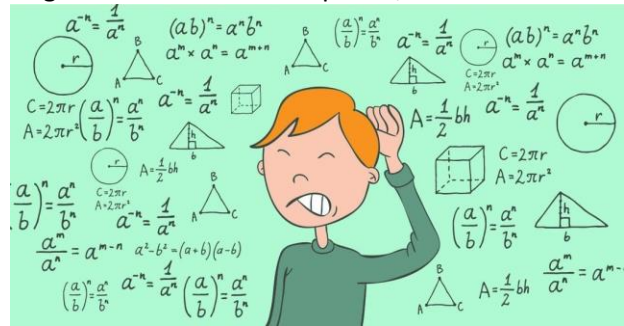
With one outcome ($x = 1$) all is clear and there is no information ($y = 0$). With two outcomes ($x = 2$) the information is one bit ($y = 1$), because we only need one question: "Is the first outcome that?" In the case of four options ($x = 4$) the two questions are enough ($y = 2$). Let's sort out the possibilities in two groups of two and ask if what we are looking for in the first group. So we choose the next double smaller group with two remaining options for the second question. In the case of eight options ($x = 8 = 2^3$) we need three questions ($y = 3$). We divide the eight into two groups of four and ask if what we are looking for in the first group. We continue with four options, as in the previous case, with two more questions. In general, when we have $x = 2^y$ options, we need $y = \log_2 x$ binary questions.

We can measure the information to different units and write using the logarithms of another base. Therefore, in addition to "binary search," I also quote a different view of the same information.

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We have seen that simultaneously (or consecutively) throwing coins and cubes results in $2 \cdot 6 = 12$ different equally-probable pairs of outcomes. Since the logarithm of the product is equal to the sum of the logarithms ($\log_b mn = \log_b m + \log_b n$ for an arbitrary basis $b > 1$), then is Hartley's information of the simultaneous throw of a coin and a dice equal to the sum of individual coin and dice information. It can be shown that only logarithm has exactly such a property that the function of the product is equal to the sum of the functions of the factors.

This is the convenience of defining information as the logarithm of number of options, due to which its consumption can be measured as a flow of electricity or water. That's why Bell's phone company strongly supported the development of this theory, which is worth talking about. For us here is enough to note that Hartley's information is a physical phenomenon. It is like energy, but it is not the same as energy.



An increasing number of (equal) options will have an increasing uncertainty, so the choice of one such will give more information. Again, with the increase in the number of options, the probability of choosing one is decreasing, so we have the conclusion that the less likely option carries more information. This is, of course, in line with intuitive understanding of information in journalism. The greater the news "the man has bitten the dog" than the news "the dog has bitten the man", because the former is less likely. What is even more important is the conclusion that from the principled splurge with as more probability is possible follows the skimping with as little information as possible. Nature has to give information, but it gives it a spoon.

Similar to Hartley's information, Weber-Fechner's law defines the amount of observation as the logarithmic function of the stimuli (irritation). However, it could also be roughly defined by the surface on which we receive the irritation. Let's look at the surface $x = y^2$ of the square side y . If x is the surface on which the stimulus acts, the length of the square is $y = \sqrt{x}$, and that is the root function given by the red curve in the previous picture. With abscissas $x = 4$ and $x = 16$ we get equal values of ordinates both square and logarithmic functions. At these two points, this root and that logarithmic function coincide, but in the adjacencies there are approximately equal values. Nothing significantly changes when we break the surface instead of squares into other figures, so we have a general, formal and satisfactory approximate conclusion. Hartley's information corresponds to the diameter of the surface, while the number of options corresponds to the surface itself, let's say to the number of elementary surfaces inside.

Similarly, the Hartley's information can be extended to the freedom the notion we have already mentioned. If a_1 is the intensity of Caesar's desire to dominate Rome and cross Rubicon, and b_1 is the power of the ban by the law of the Senate, then $S_1 = a_1 b_1$ is the Caesar's charisma. For different cases, the sum of such ($S = S_1 + S_2 + \dots + S_n$) is the "energy" that radiates from the person that it threatens or draws attention to itself and attracts other people. We recognize the previously mentioned liveness.

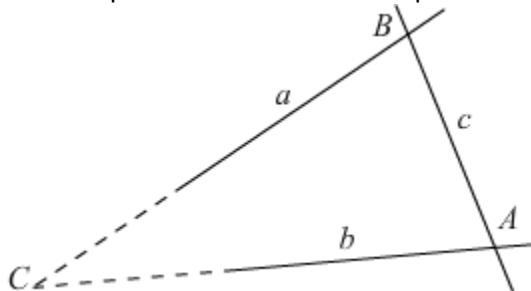
Emergence of present

From the assumption that there is uncertainty that is realized in the information is followed by the conclusion that this information is observed just "now". The present is the realization of physical uncertainty into the physical information, and we are witnesses of this emergence. Simply put, a slice on the slice before us creates the space, time, and matter as the realization of the most probable events. As long as a force does not work on the object we are observing, it will emerge in new and new moments in the same place in the same environment, because it is the only force that can change the probability. There are several statements that have to be proved here, which is usually an unpopular process. Instead of that, I will convince one of them and somehow interpret it with an easier explanation.

In addition to certainty, there are also coincidences, first I took as an assumption, an axiom. This means that in the beginning I had nothing as convincing as the proof of the theorem, so I put it off. In order to challenge the assumption, we must try to find out some contradiction in the resulting theory or to show that there is none, comparing it with equivalence with an earlier undoubted. Again, this is a proving method that has long been known for mathematics, but in physics it turns out to be heresy. What will the evidence of known laws of physics prove to us from the opposite assumption (the opposite of causality) if the old are also good?

The method of proving by reducing it to contradiction was discovered in ancient Greece. The Greeks first noticed that from the untruth by the good deduction can be obtained both the truth and untruth, that is, contradiction, but the truth can only be obtained from the truth. Finding the contradiction, we would find that the assumption is incorrect. This discovery has been developed to the limit of its widely known Euclidean geometry. In addition, the starting point for their deductions was five postulates, attitudes without which they could not, and which seemed to them simple enough and obviously that should not be proven. However, one of them, the fifth postulate, was strangely obscure and did not fit into that story. That's why in centuries, then through millennia, persisted, always failing attempts by the best world mathematicians to prove that postulate from the previous four.

The fifth postulate talks about the parallelism of the straight lines. By definition, the two lines are parallel if they coincide or belong to the same plane and do not have common points. It further claims that from a given point out of a line in the same plane we can only draw one line parallel to the given. This is explicit enough to produce various consequences, but not simply enough. For example, in the picture on the left, if the lines a and b are parallel, then the angle in the vertex C is zero, and for angles in the vertices A and B we



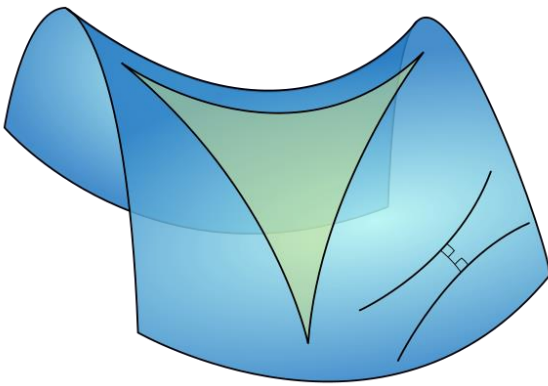
can say that they are supplementary, i.e. $\angle A + \angle B = 180^\circ$. And if the lines are not parallel, they intersect, so the sum of the inner angles of the triangle ABC again is 180° . The sum of the interior angles of each triangle is always the same, the straight angle. From the fifth postulate it follows that the ratio of the circumference of a circle and the circle diameter is a constant number $\pi = 3,14159\dots$, but also many other theorems.

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Without this postulate, many well-known theorems, seemingly unquestionable and obvious statements, do not apply, and yet it was not possible to carry out the fifth postulate from something quite simple. This dilemma was resolved by Lobachevsky³⁶ in the original way. He assumed the opposite, that the first four postulates of Euclidean geometry were correct, but not the fifth, which he denied. He put that at a given point out of the line, we can pull at least the two different non-cutting lines at the same plane.

Lobachevsky systematically developed his geometry. He proved, for example, that the sum of the angles in a triangle is always smaller than 180° and that it is as less the triangle is greater. Also, the ratio of the circumference and the circle diameter is smaller than π and it is the smaller if the the circle is greater. He then discovered the famous Lobachevsky's geometry of today, but his contemporaries could not "burn" so much truth at once, so they took away the title of professor of mathematics, doubting his common sense and, for consolation, let him work as a librarian at the academy.

Lobachevsky further proved that his geometry is equivalent to Euclidean, more precisely, that both are either true or at the same time incorrect. He took this equivalence to observe the chords of the circle



(lengths between two points on the circle) of Euclidean geometry, noting that for them, considered them as lines, all five of his axioms were valid. Also, in Euclidean geometry, he noted that the saddle surfaces (pictures on the left) on which the straight lines are represented by the shortest distances between the given points, possess an internal geometry equivalent to its. Lobachevsky proved that the fifth postulate was independent of the other four. That is why all the attempts of his predecessors were unsuccessful. I note, these

postulates are quite different today.

The lesson left by Lobachevsky is that we can have both possibilities. There is the possibility that the real world can be constructed from both assumptions, with the deterministic arrangement of some of its aspects and with the objective coincidence of others. For example, there are the deterministic laws of conservation energy, momentum, mass, spin, information, and the non-deterministic process of collapse of the superposition of quantum states into one of the outcomes. Nevertheless, in order to strengthen the initial theory, I added the principle of finiteness of matter. As we have seen, this principle is almost provable from the unacceptable features of infinity, and on the other hand it limits the partition of any property of matter, so to us ultimately remains an atomized objective uncertainty.

We continue with the principle of probability, most likely to happen most often. This means accepting both random events and the laws of the Kolmogorov's probability. Moreover, the uncertainties already discovered in quantum mechanics will now be recognized as "ours". That is why I can say: I am where I am and not in some other place, because in the given circumstances My position is here most likely. However; He is there, and from His point of view His position must be most likely. By the way, we see that probability is a relative phenomenon.

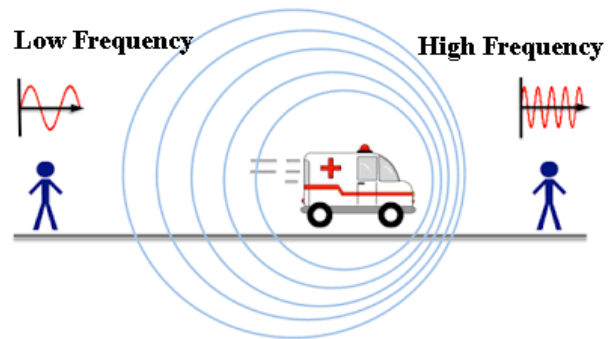
³⁶ Nikolay Ivanovich Lobachevsky (1792-1856), Russian mathematician

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I hope you know something from Einstein's special theory of relativity. For example, the assumption that the laws of physics are the same in all inertial systems, that is in uniform straight-line motion. Also, the speed of light is independent of the speed of the light source. One of the many consequences of the mentioned principles of relativity is the contraction of the length along the direction of motion, and the second is the slowing (dilatation) of the relative flow of time relative to the time of the observer who is stationary.

Because of this second, in two systems in relative motion, the notion of concurrency of time is not common. Because the time runs slower in the mobile system, when it is coming to us, it is simultaneous with events from our future, so that at the time of passing by, they both have the same present. Conversely, when it had passed by and the relative system leaves us, its time lag behind in our past. Therefore, the wavelengths of incoming and outgoing sources of electromagnetic waves tell us something about our future and the past.

Similar to the Doppler Effect for sound, which we see on the picture on the right, there is also Doppler Effect for light and electromagnetic waves. The siren of the outpatient vehicles that are approaching us has higher tones than at rest, with the sound of shorter wavelengths. Conversely, the siren that goes away has lower tones, the sounds of larger wavelengths.



The short wavelength of the light of the source approaching us now is seen as the smudging of photons (light particles), its precise position, or greater density of probability of position. The light from the source that is moving away from us has greater wavelengths, which means less probability of finding in a given place. With this and the mentioned slowing down of the time, we conclude that future light positions are more likely than the present, and the present are more likely than the past.

Since the relativistic Doppler Effect applies to all wave-particles, then the previous conclusion is the general occurrence of a substance. That is why our present is moving towards the future and not towards the past, as more likely events is realized. In this conclusion, we recognize the principle of probability combined with Doppler Effect. However, the similar conclusion can be made directly, only from the point of view of the principle of information. Namely, the movement of the present to the future is the movement in lesser spending of uncertainty and the generating of less information than in the case of reversed movement in time. Hence the absurd conclusion is that the prediction of the future is the informational less complex process than the reconstruction of the past.

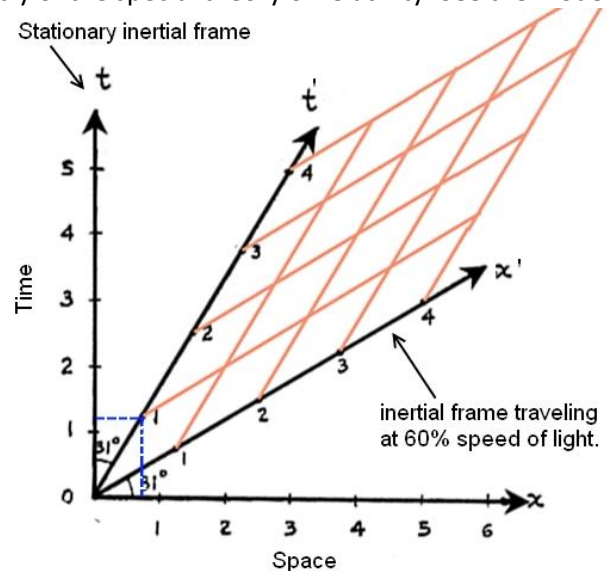
I hope that now you will not be too complicated to find out when there is more dimension of time. When it turns out that the world of time flows is at least three-dimensional, and then the previous conclusion will have to generalize to the movement of the present in the most probable direction in the 3-D world of time, that is, in the direction in which the production of information is the smallest relative to us now.

Dimensions of time

If there were only one resting system, or more of them moving inertial, but only along a straight line, then only one dimension (1-D) of time would be sufficient for us. It would not be possible to go into another dimension of space, because such a turn would require the operation of some lateral force. This stems from Newton's law of inertia. I will try to convince you now that three dimensions of (3-D) time, that is, six dimensions (6-D) space-time, are required for the movement in three spatial dimensions (length, width, height).

First of all, this is evident from the space-time geometry of the special theory of relativity. See the model space-time of Minkowski in one plane, in the picture on right. The rest system is Oxt , the $Ox't'$ in movement. Both move along the same abscise (x -axis) at a mutual speed of about 60% of the speed of light. The moving time axis of the mobile system is inclined towards the direction of movement.

One plane is sufficient to define Lorentz³⁷ transformations of a special theory of relativity, since the movement by abscise does not produce a relativistic change of the vertical axes, ordinates (y -axis) and applicate (z -axes). However, for this reason, we note that a similar movement along the other direction will lead to the inclination of the corresponding time axis in that direction, which means that we need as many dimensions of time as we have the dimension of space.



We will see more evidence, but before we go on, let's expand this to the general theory of relativity. It derives from Einstein's³⁸ tensor field equations. We know that the general theory is reduced to a special theory of relativity in a trivial case (zero-field), and it is approximately reduced to Newton's theory in the case of a central field, such as Earth or the Sun. The first solution of Einstein's equations for the central symmetric gravitational field was found by Schwarzschild³⁹, and we do not need to do it further, especially since each gravitational field can be decompose on the similar central.

From Schwarzschild's solution we know that closer to the center of gravity the time runs relatively slower, compared to the distant observer, and that the radial lengths (on the direction of the force) are shorter. In the ever-increasing central field, there is an ever-increasing body squeeze that has not been observed in Newton at one time, although an attractive force is directed toward the same center in both cases. This new field effect is understood by a markedly different force at the beginning and at the end of large radial lengths, as well as significant force differences on shorter radial lengths in the case of extremely strong fields.

³⁷ Hendrik Lorentz (1853-1928), Dutch physicist.

³⁸ Albert Einstein (1879-1955), theoretical physicist born in Germany.

³⁹ Karl Schwarzschild (1873-1916), German physicist and astronomer.

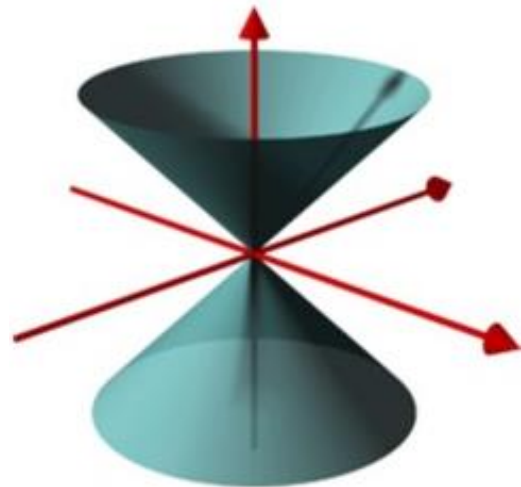
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This last point is because it can be shown that the central field can nevertheless be represented by a set of infinitesimal Minkowski plains. With a satisfactory approximation around the field, we can set up small systems of 2-D coordinates of space-time at each point with spatial axes, always directed towards the center of the field, and with its time axis inclined to the spatial. The time axis is the more inclined towards its spatial, as the field stronger, but spatial always follows the direction of force, so it is obvious that the time axes themselves form a 3-D space, that is, such a space-time extends into (at least) six dimensions.

It would be metric proofs of the 6-dimensionality of real space-time. However, they can also be found topologically. When we remove the possibility of measurement and all the consequences from geometry, we get a topology (Greek τόπος - place, λόγος - knowledge), the branch of mathematics that studies global geometric structures. How to count the dimensions of the space in which we cannot use terms: distance, length, area, volume?

The point and each finite (or at most countable) set of points have no dimensions ($n = 0$). As usual, we mean that space can be a continuum. One point or several points can divide the line into two or more continuous lines, separating them completely, so we say that the line dimension is one larger than the point dimension ($n = 1$). The final set of lines is the same dimension as one line. The surface can be similarly divided by the lines, completely separating them. For example, the circle divides the plane into the interior and exterior of the circle, but such a split cannot be achieved by several points. Therefore, the dimension of plane is exactly one larger than the dimension of the line ($n = 2$). Three-dimensional space can be divided by one plane into two separate half-spaces, so the space has one dimension more than the plane ($n = 3$).

The complete present at any time always makes one 3-D space, in the sense of the stated topological dimension definition. This also agrees with the results of defining dimensions in (many) other ways. Within the special theory of relativity, when we have only a uniform straight-line, inertial movement of one pair of coordinate systems, the present of one of them will separate the past from the future of the world. That is why such a world is one dimension larger ($n = 4$) than the present, which is presented on the right picture. The Upper Cup is the future, the bottom is the past, and them separates the 2-D plane which is the present.



However, in reality we do not have only one pair in inertial motion, and we have gravitational fields. There is no unique "now" of all these systems, which means there is no 3-D space that will separate the world into the past and the future, like the way in the given image. This means that space-time has at least five dimensions.

The impossibility of clock synchronization in the theory of relativity, because of the lack of a common present, Einstein himself noticed in his first works. He nevertheless represented only four dimensions of space-time, since increasing this number would mean the abandonment of determinism. Let us recall

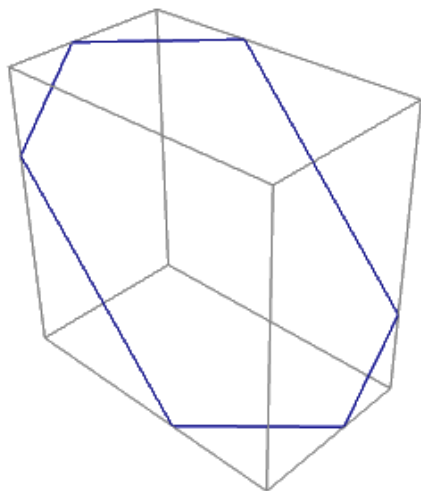
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that determinism had its foothold in mechanicalism and classical mechanics of the 19th century, and Einstein's theory of relativity should have been merely a minor complement to the knowledge of the time. When the quantum mechanics later grew, although one of its important founders, Einstein considered the formal basis of that theory inaccurate.

Using the definition of topology, we see that space-time has (at least) six dimensions, as follows. Imagine a 4-D object, let's say a prison cell made to last. The walls form three spatial dimensions, and their duration goes through the fourth (one) time dimension. Without maintenance, this building spontaneously deteriorates, but it can be hit by faster, violent demolition. Therefore, it is not possible to isolate the "interior" from the "outer space" of space-time using the four dimensions, which means that space-time has more than five dimensions.

These repercussions result into many consequences, some of which are already recognized. The forces are for which there are the fifth and sixth dimensions of space-time that is the second and third dimension of time. The same can be said for (objective) uncertainty. Also, the same could be said for the relative concept of the present, and then for the relativity of the probability of perception. In this summary we can add the principle of information with the consequence that My present goes to the most probable My realizations, which means to the least (for me) the production of information. You can place "My" on any subject, say the particle. This gets even more meaning after engaging in debates about parallel realities.

Namely, the electromagnetic waves of the source in motion show (on average) larger wavelengths, both in the direction of movement and perpendicular to that direction, which is known from the relativistic Doppler Effect. This increase is exactly proportional to the slowdown of time. Therefore, the likelihood of photon positions is reduced from what follows the law of inertia, but on the other hand it should result in increased production of information. However, the relative (observed from the system at rest)



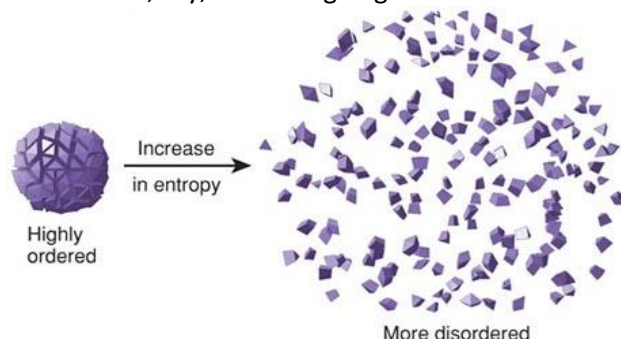
the production of information is less, since the time of the moving system slows down. This, for a relative observer, is the loss of time that his proper observer (in the mobile system) does not notice, in fact, the excess of time has gone to a parallel reality. The relative observer only observes the remaining part of the time-flow of the moving system that is in its reality, because with the rest, communication is not possible for it.

So, our space-time, what we can observe from one of the parallel realities, really has only four dimensions, three spatial and one time, and the rest of the dimensions are seen as a cross-section or a projection. In the figure on the left we see a similar one such a cross section of the cuboid and plane as the blue-edged lines of the hexagon that represent the boundaries of the cuboid in that cross-section. Analogous are the phenomena of the 6-D world that we observe in the "strange" consequences of relativity theory, on the boundaries of the possibility of our 4-D physical observations. The fact that we can convey the knowledge of the existence of truths beyond physical perceptions fits quite well with the concept of this theory.

Entropy

Entropy is a measure of system disorder. Even if we barely know what are the thermodynamic systems with an equally probable microstate arrangement, whose entropy is measured, in this definition we will recognize some kind of information. Information is a measure of uncertainty before the occurrence of a random event. In the simplest case, we express the logarithm of the number of (equally probable) options, and thus express the entropy.

Microstates, say, are arranged gas molecules in the room. The most likely is the uniform distribution of



molecules throughout the entire space, and the least likely are all the molecules concentrated about one place. Therefore, the gas entropy S is proportional to the logarithm of the number of evenly distributed w schedules of its particles. It discovered Boltzmann⁴⁰ in the formula

$$S = k_B \ln w.$$

Choosing the logarithm basis $e = 2,71828\dots$, we determine $k_B \approx 1,38 \times 10^{-23} \text{ J / K}$, i.e. Boltzmann

constant. As the nature strives to more probable states, so we have spontaneous growth of entropy.

By combining it, we prove that it is most likely of all the schedules of the molecules in the room just the one that is spatially uniform. Let's imagine nine equal balls and the same number of boxes, their positions. Let's look at the balls as different individuals of equal qualities. We can sort nine of them in one line in $9! = 1 \cdot 2 \cdot \dots \cdot 9$ ways, and all nine can be put in only one box in only nine ways (as much as the boxes). The first number is many times larger than the other, and so are the chances that we will find the balls in one of these many schedules. With the increase in the number of balls, this difference is growing even more rapidly, and for huge numbers, such as the number of molecules in the room, thick schedules become (almost) impossible events.

Why the number of schedules of all balls in one line is equal to the factorial number of balls ($9!$) we can understand in the following way. In the first position we place any of the nine balls. Of the remaining eight, choose one arbitrarily, which means that the first two positions can be filled in the $9 \cdot 8 = 72$ ways. For the third position, we can choose any of the seven remaining balls, so there are $9 \cdot 8 \cdot 7 = 504$ ways to form these three positions. By continuing, we get the number $9! = 9 \cdot 8 \cdot \dots \cdot 1$ of ways of deploying all the balls.

The relationship between the number of most probable schedules ($w = 9!$) of atoms and entropy ($S = k_B \ln w$) was discovered by Boltzmann since 1872. His ingenuity is all the greater that Hartley realized the information for half a century later. Atomicism was then contested, because something so small that one cannot see and feel, physics should not be taken seriously – claimed Mach⁴¹, one of the leading scientists of that period. He rose up at one Boltzmann's lecture, turned to the audience and

⁴⁰ Ludwig Boltzmann (1844-1906), Austrian mathematician and physicist.

⁴¹ Ernst Mach (1838-1916), Austrian physicist and philosopher.

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shouted: "People, do not listen to this man, he's a fool, no atoms exist!" In a deep state of depression, Boltzmann quickly later killed himself. Irony of fate, the idea of atoms is only a few years after Boltzmann's death accepted in physics.

Here we look at entropy through principles of probability and information, which are completely new, so do not expect the ways and consequences of these considerations found in modern physics textbooks. It is enough to recognize logic and only those places in the science that are worth. One such place, I believe, could be to calculate the number of combinations of entropy for the duration. Calculating the number w as the most likely schedule of an abstract combinatorics does not include time.

By slowing down the time, the reception of the same information slows down, so with a simple account we can see that the number of combinations changes with the coefficient of the speed of the time flow. Without going into further changes of the combination due to the length contraction in the direction of motion, we can understand that entropy is a relative phenomenon as well as time and decreases with the speed of relative system. The system in inertial motion, observed from the resting system, has a slower flow of time and the same time reduced entropy! I note, however obvious to you, this is the result that modern physics does not know (and therefore does not recognize), so I have to clarify it.

Because the entropy of the mobile system is smaller (the dilation of time) and because the physical system spontaneously goes into a state of higher entropy, the body from the state of rest will not spontaneously move into the state of motion. Therefore, this discovery agrees with the law of inertia. With the same explanation a paradox goes, which, as we have said, resolves the parallel realities.

Namely, the wavelengths of light from the mobile source are larger (Doppler Effect), and this is inter-



preted by the greater smearing of the photons on the road, or the lower probability density. This is a universal phenomenon that applies to all kinds of wave-particles, so they do not turn to their less likely path, which is in accordance with the law of inertia.

This kind of uncertainty produces a surplus of information that remains in a parallel reality which is inaccessible to reference observer. The relative and proper observer, one from an external restraint system and one in moving system, one part of the resulting information cannot exchange, which is a part of the impossible communication due to pseudo-reality. The particle seems to disappear as a relative observer, along with its world of information, as far as less probable positions of greater wavelength are concerned.

On the other hand, slowing down of time makes moving bodies more inert. Exactly how many times the time runs slower, the body masses are increased. In the same way the energy is increased, with the excess energy of bodies in motion being called kinetic energy. This coefficient of proportionality

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}},$$

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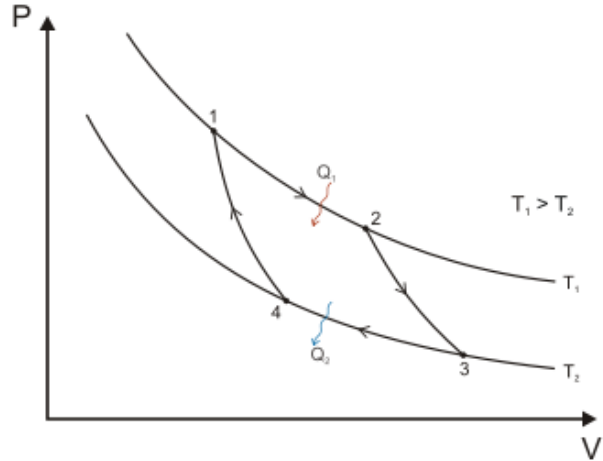
where v is the speed of the moving system, and $c \approx 3 \times 10^8$ m / s speed of light in a vacuum, is called relativistic or Lorentz factor. With it we can write the mentioned formulas:

$$\Delta l = \Delta l_0 / \gamma, \quad \Delta t = \Delta t_0 \gamma, \quad S = S / \gamma, \quad m = m_0 \gamma, \quad E = E_0 \gamma \approx E_0 + \frac{m_0 v^2}{2},$$

where on left of each equality are relative values, on right their proper with zero index, respectively: the length in the direction of motion, time, entropy, mass and energy. The last item $E_k = m_0 v^2 / 2$ is kinetic energy. I cite them mainly for curiosity.

Only the third of these formulas, for entropy, will not be found in modern physics textbooks, so I will only explain it a little.

Boltzmann came to his entropy formula by studying the circular processes of thermal machines. These processes, on the picture on the right, were discovered by Carnot⁴², followed by the development of thermodynamics. Clausius⁴³ then observed the constant $S = Q/T$, a fraction of heat and the body temperature, in the calculations of the flows of thermodynamic processes and called it entropy, without giving it any physical meaning. We will skip here the details of performing otherwise well-known laws of thermodynamics and immediately switch to the unknown.



We will assume that the relative heat of the body

in motion is equal to its proper, the own energy of the body at rest, considering that by motion only the kinetic energy increases. Therefore, because we consider that the relative entropy is smaller, the relative temperature will be higher according to the Clausius formula. More precisely, $T = T_0 \gamma$, by which we reconcile the Clausius formula with the previous relativistic, or Boltzmann's.

Now comes the full expression of the formula for the relative λ and proper λ_0 wavelength of the relativistic Doppler Effect. We write it in a common form $\lambda = \lambda_0 \gamma$, for observing in the direction of the radiation movement (longitudinally) for the mean value of the incoming and outgoing sources, that is, for observation perpendicular to the direction of movement (transversal). Wave-lengths of the body (waves-particles) in movement are increasing, as are the waves of light that make the shift from blue to red, hence from a colder to warmer. We will simply interpret this by increasing the relative body temperature, of course, without increasing the thermal energy of the body. When such a body hits an obstacle and stops, then its kinetic energy passes into the heat.

⁴² Nicolas Léonard Sadi Carnot (1796-1832), French military engineer and physicist.

⁴³ Rudolf Clausius (1822-1888), German mathematician and physicist.

Pseudo-truth

What if the gods do not exist and we behave like they are? What then is the transmission of information and interaction done? It is about a real, as well as the change of the world by blind faith or movement of both, the faith and force, by hope. This is because the truth is made from lies too, as quite falsehoods can be quite accurate, that is, because with even incorrect statements it is possible to build up a correct one.

A mathematical statement is a proposition that is true T or false \perp , and the third is not (lat. *tertium non datur*). The negation of true is false statement, and the negation of the false is true. This is one of the old puzzles of philosophy in general that is no longer discussed in mathematics, especially after the proof that any polyvalent logic, with a scale of the values true-perhaps-incorrect, can be reduced to a duals true-false. From this algebra logic, it is useful to recognize at least some other important achievements.

Tautology is a statement that is always true, and contradiction is a statement that is always false. If p is a statement, then the sentence $p \vee \neg p$ (p or negation p) is tautology. The sentence $p \wedge \neg p$ (p and negation p) is the contradiction. Many tautologies are known as useless or termagant claims, such as "white is white" or "If today is Friday, then it is not Thursday!".

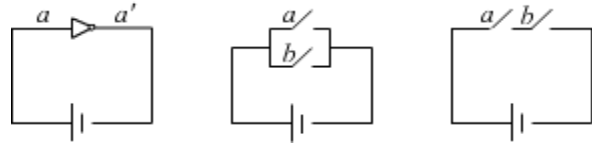


However, some tautologies are not obvious. Let's say, "If there is a God, then if there is no God then today is Friday". We write this sentence with a formula where instead of "there is a God" stands p , and q instead of "today is Friday". There are four possibilities for statements p and q . Both are correct, the first is true and the other is incorrect, the first is incorrect and the other is true, both are incorrect. Incorporating one option at a time and since the implication is incorrect only in the case when the assumption is correct and the result is incorrect, it can be proved that the above sentence is always correct. Of course, there are even more complex sentences that are more difficult to verify, and also, in addition, not all of the statements are tautology or contradiction.

Every algebraic logic formula can be reduced on to only three operations: negation $\neg a$ (not- a), disjunction $a \vee b$ (a or b) and conjunction $a \wedge b$ (a and b). This discovery was followed by the tumultuous development of the computer. The states "have currents" and "no current" are changed with the statements "true" and "false", more clearly we refer to them as numbers 1 and 0, negation a we write a' , disjunction as summation, and conjunction as multiplication. Then, we construct switches that work in the electric circuit as negation, disjunction and conjunction of the current flow, so we gather enough to simulate every sentence you want to install in the given computer. As we know, this task has proved to be resolute.

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In the next figure on the right there are three simple circuit gates simulating negation, disjunction and conjunction, from left to right. Here they are shown as evidence of the possibilities of the described program of construction, but these images in the technique are replaced by smaller symbols. In such schemes, you will notice that knowing a' you can know the value of the input a into the negation, but after knowing the value of the outputs from the disjunction or conjunction you cannot know values of inputs a and b . Therefore, we say that disjunction and conjunction are not regular functions (for them there are no inverse functions), that is, they are not feedback switches. However, there are reversing switches that are also universal, in the sense that they can obtain each of the previous (negations, disjunctions and conjunctions), that is, each algebra logic formula.



In classical technique, the most famous universal feedback switch or gate is Fredkin, and in quantum it is the Hadamard gate, switch or valve. I described them in greater detail in the book "Quantum Mechanics" [1]. What must be pointed out here is that all the quantum evolutions we are surrounded behave as if they go through Hadamard similar valves. Namely, quantum processes take place as if they are constantly passing through a universal feedback circuit. It is a wonder that has some simple consequences, many of which were known even before this ascertainment.

All quantum systems (for example, the hydrogen atom) are transformed by unitary operators which are among the simpler in vector space theory, so that each quantum system is representation of the vector space. The vector represents a quantum state, it is spanned (extended) by the observables (physically measurable sizes) as the base vectors, and the change of this state is a linear (unitary) operator. It is an unusually universal, abstract construction that, like a multiplication table, can be applied to all sorts and which, in the world of quantum physics, leads to astounding precise prediction. There is no field of physics in which experiments can be predicted with as much accuracy as in quantum mechanics, and yet, which is less clear to us.

Second, unitary operators represent rotations. Formal, quantum changes are the change of position relative to the physical quantities equivalent to the rotations of that state vector relative to the orthonormal observables. It sounds abstract, but it's even weirder when you know the area of mathematics and when you realize that it works in quantum physics. Moreover, operators also made the vector space, so the quantum changes themselves are formally equivalent type of representation the same reality of the quantum world they change.

Thirdly, in quantum-mechanical processes, information is not lost, yet these processes always run as



little information as possible. In order to resolve this paradox and to respect the principle of information (savings), it is clear that uncertainty (unrealized information) should also be considered as a kind of information. Formally, this is not a problem, but we are concerned with the essence when we ask the question: "Whose information is this uncertainty"? The very mathematics of

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quantum mechanics allows the existence of an observer (particle) whose time flow run opposite of ours, and they may then exist.

The transformation of uncertainty into information, for the observer with the reverse time flow, would be the opposite process of ours. There are many options that could been realized for us, of which only one is visible and the rest are in inaccessible parallel realities, for such are real uncertainties. But only one of our uncertainties is accessible to him, while the others remained in parallel realities. Such, like as we, achieves the realization of a minimum of information, the principle of information is satisfied, and in his world more data are needed for reconstructing the past than for predicting the future.

We cannot (realistically) communicate with the inverse time traveler because the questions we ask him must have been answered before he gets them, and because of the objectivity of uncertainty, this is not possible. That is why the elementary particles are in communication also elementary, because the data they exchange must be "kicked on the first ball" without understanding them. That is why the past, as well as the future are (mostly) pseudo-real, especially to him and us.

It is interesting that in ancient Greek mythology we can find the analogies with these discoveries. For



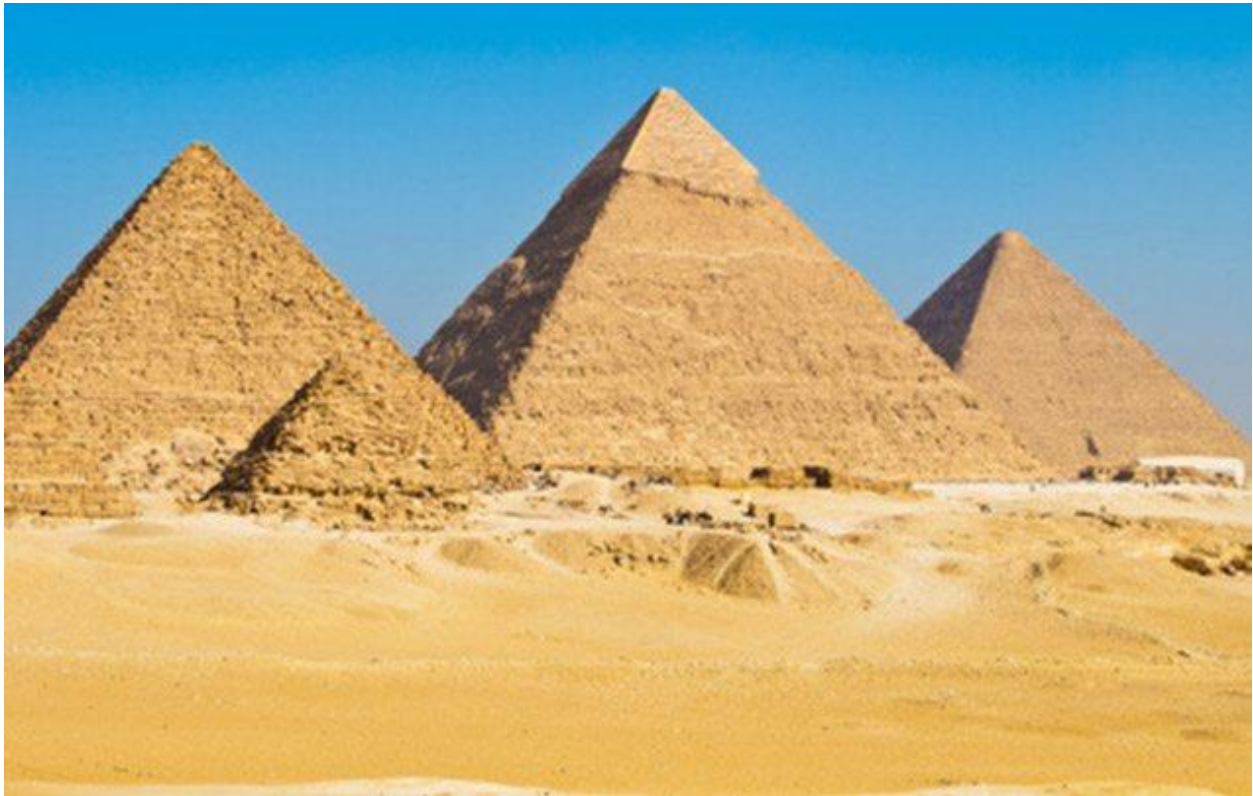
example, such is the dependence of the ultimate from the infinite find in the dependence of the mortal people on the immortal gods. The impossibility that even the gods manage the fate we saw in the drawing the draw. That this may not only be Zeus's manipulation in taking over the inheritance and leadership from the Hades, we are also suspected of the impossibility of Zeus's wife Here to kill his extramarital son Hercules, shown in the picture on the left. Hercules destiny was determined by immortality, which even the gods cannot change, so Hera puts him on various troubles that at least make his life worse.

Here we come to another possibility that becomes an interesting question about the uncertainty of quantum mechanics. This is a question of the ultimate fate, with a similar response to chaotic movements that seem unpredictable and uncontrollable, which ultimately are reduced to periodic repetitions, to attractors. With the same logic that we approached to these periods, we foresee that many crudely and objectively unpredictable ways, through which we partly walk through multiverse, can eventually come to similar outcomes. This would not mean that the fate of each individual is predetermined, as far as the predestination of the whole of the universe is predetermined.

Hercules's physical strength is one that works for him, similar to a force that changes probability. The ancient Greeks do not celebrate hedonism as the ultimate goal of man, which is essentially a contemporary aim for human rights now. They celebrate suffering and the victory of originality over uncertainty. For them, facing fears is what liberty is for us. And these are formally very similar concepts. For example, there is greater freedom in greater uncertainty, and both, uncertainty and fear are melting with the same. Facing it with uncertainty we eliminate it, just as fear is treated with fear. The universe moves in proportion to the forces, Hercules with its limited, but enormous human power.

Light

Ancient Egypt is a civilization of the ancient North African originated in the year 3150 before the new era around the lower course of the Nile River where today the state of Egypt is. From the time of the Early Dynasty we have the oldest record of the Egyptian letter, the first calendar, horse-drawn carriages. The Old Kingdom begins 2686 BC with the 3rd dynasty, by the great centralization of the state, the improvement of government, administration, tax system and large construction enterprises. The Cheops pyramid in Giza, on the picture, was built around 2560 BC in the time of the 4th dynasty. The period of this kingdom ends with the disintegration of Egypt at the end of the 8th dynasty around 2160 BC. The old Egyptian civilization fell and rose until the end of the 26 dynasty in 525.



From the period before the dynasties and pharaohs (6000-3150 BC), the Egyptian culture determines the warm climate, periodic flooding of the Nile, and faith in the gods. According to myth, before the universe there was a chaos. The water and darkness where everywhere, out of gods. Then an island of mud emerged from the water, the first sacrificial altar was created, the demigods came out of the darkness and picked up the reed that was spilled on the shore, and the divine falcon landed on the reed. Later, the cult of truth, sun, sky, growth and the lives of the dead developed.

In ancient Egypt, inheritance was not transmitted by a female line, although their civilization was not as masculine as the next Greece. The Hathor was the goddess of joy and love, Heaven and the West where live dead. The Maat was the goddess of truth and righteousness, daughter of Ra, the Sun God, with a pen of "truth" on the head with which she weighed an immortal part from the heart of the deceased which in a decent must be lighter than a feather. Otherwise, he would be thrown to the beasts.

Universe

From the first written history until recently we have found that the world made the Earth, the Sun and the Sky. The Heaven is generally considered a vault of stars, more or less inaccessible to people, and together with that accessible to us the world emerged by a creation. Here somewhere is the end of the story of the universe with which modern science could agree. Today we believe that the universe was created by the Big Bang before 13.7 billion years ago and has been expanding ever since. It consists of hundreds of billions of galaxies consisting of hundreds of billions of stars, but also of other bodies gathered by gravity forces. These galaxies are the islands in the overwhelming emptiness, which (on average) are moving away from each other as faster as they are further.



They are now a topic. We will not assume that the modern understanding of the space is true and definite, only so that we can adjust it according to the new principles and consequences that we have known so far. The very idea of creating space, time and matter by explosion and the expansion of space is not in conflict with the principle of finality, and we will not change that. The spread is consistent with the spontaneous increase in entropy, which is a consequence of the principle of information. Due to the saving in the production of information, the production of time is slower. In other words, the aging of the universe slows down by the time!

A slowdown in the time of the universe would mean that we observe the faster distancing of the further galaxies, rather than their "real" movement, because what we see now is actually the events of billions of years ago how much light should arrive. This result is a well-known hypothesis, on the other hand, by Spanish researchers⁴⁴. I note that their theory, like string theory, for now have little to do with this, regardless of the possible results.

Final and infinite sets are concerned with topology and functional analysis. By definition, an open set of points X is the one in which from each point $x \in X$ we can cross a little distance in any direction, and to remain in the array X . For example, the interval $(0,1)$ of real numbers, with no boundary numbers 0 and 1, is open. Indeed, if we take an arbitrary number $x \in (0,1)$, then there are two numbers $x/2$ and $(x+1)/2$, both in the same interval, but the first is closer to the left border, and the other to the right.

For any universal set U , we say that its subsets S and S' are complementary if the union of them is the universal set, $S \cup S' = U$, and the intersection, $S \cap S' = \emptyset$, is empty set. A closed set is defined as an open complement. The interval $[0, 1]$ of real numbers containing boundary numbers 0 and 1 is closed. Each at most infinitely countable set of points is closed. Open and closed sets are not mutually exclusive because there are open-closed sets, such as the interval $[0,1)$, closed by zero, and open to one.

The only sets that are simultaneously open and closed are an empty set and a whole space. It now gives a new light and the universe and the vacuum. Vacuum and the universe are the only material-immaterial

⁴⁴ see [8]

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objects; these are the only finite-infinite bodies of this theory, given the principle of the finiteness of matter. And that has its consequences.

By the aging the time slows down, so from any point of view from the past it can be said that it will last infinitely long. It is similarly, looking from a distant position, to the deterioration of the body in a black hole, an object of so great mass and gravity that the light cannot escape from its surroundings. Outside looking the particle that goes into the black hole has slower and slower flows of time until it stops at the boundary sphere called horizon event. From that point of view, it never comes to the black hole, although from the point of view of the particle itself, its passage through the horizon of events will be short-lived.

By slowing the time, the body becomes more inert, its relative energy increases. If time runs slower to stop, then energy rises to infinity. It is in accordance with the principle of finality. On the other hand, it opens a problem with the law of energy conservation, and we need to consider this too.



In the image of the 2-D model of the universe to the right, the time flows from the bottom up, the space expands. The edge of this reverse hat is the boundary of the visible universe, and the spike itself is the beginning of the expansion, the so-called inflation. The light from the lower part does not reach us, because it is not fast enough. There is a limit beyond which we cannot see the oldest, the farthest galaxy of us, and beyond this limit, there is more and more matter due to the constant expansion. This matter, which is beyond the boundaries of the visible universe, is left behind in the real past, is even deeper in pseudo-reality.

From the point of view of an abstract observer, which we imagine fixed somewhere on this side of the visible universe, how much we get on the mass because of the slowdown of time so much mass we are losing beyond the limit of visibility. From our point of view, of our own (proper) time, the distant galaxies that would stand motionless we would see in the past with faster time flow. However, they are moving away from us, the faster they are farther, and due to the increase in the kinetic energy (only) by motion, they can have the same total sum of energies.

These are, of course, the hypothetical conclusions that I hold for the moment as long as they are derived from too little assumptions. But the knowledge of the universe that we have today is definitely better than what the old peoples used to do, so I can use it to look at the part of the theory I represent. On the other hand, there are considerations of closed-open sets that are especially interesting for the application and paradoxical duality of matter. In short, in this part of this story, I will try to connect quantum views of the vacuum with cosmology.

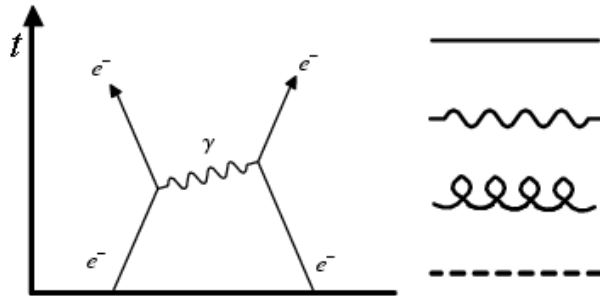
Heisenberg's uncertainty relations were discovered at the very beginnings of quantum mechanics in the early 20th century. I recall that they are talking about a constant product of ΔE the uncertainty of energy E measurement and Δt the uncertainty of measuring the time t , the moment of observation of that energy. This product is (slightly smaller than) the order of the size of Planck's constant

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$h \approx 6,63 \times 10^{-34} \text{ m}^2 \text{ kg/s}$, so we write $\Delta E \cdot \Delta t \geq h$. The same applies to the uncertainty of the momentum and position $\Delta p \cdot \Delta x \geq h$ along the same axis.

In the case of a vacuum, the first relation of uncertainty means that in every interval of time $\Delta t > 0$ a particle (here positive) energy $\Delta E < h/\Delta t$ may appear, which will not violate the laws of physics. From today's numerous experimental confirmations we know that the vacuum is driven by such particles. We call them virtual particles.

In the image of the Feynman⁴⁵ diagram to the left, γ is a virtual photon, with e^- are marked bounce



electrons. Horizontal axis is spatial, vertical is time. The electromagnetic field generated by the electron radiates the (spheres) of virtual photons, which become real when interacting with another electron. Then laws of maintenance are in place.

For the total momentum of two electrons and photon, the law of conservation is valid, so the

electrons are rejected. The left goes to the left of the absciss in the picture, and right to the right. They are rejected as boats on the lake, when from one were thrown the sandbag into the other. Similarly transmits the energy and spin, as well as information. When such transfer is done by virtual fermions (particles of spin $\pm \frac{1}{2}$), we represent them with a straight line, shown on the same image up and right. The following code below is a wave line, reserved for photons. Gluons are usually represented by loops, the third line from above, and the fourth dashed is Higgs boson.

Due to the law of conservation and relativity of observation, physical properties have another rarely noticed property. Uncertainty prior to the realization of a random event becomes information after⁴⁶. The total amount of "uncertainty plus information" of a particular closed system of any random event is constant, it does not change during the production of the information. It is the constant of the system, so it is the constant of the universe. However, the information produced in its quantity is not the same for each, any proper or relative observer, because otherwise the universe would quickly waste its uncertainty. There are many more relative observers than the proper, but relative ones see smaller production of information then its own for each random realization, so (proper) space lasts.

So, when in a small interval of time Δt happened a creation of a virtual pair of particle and its antiparticle of total energy ΔE , this energy is unlimitedly large if the interval is infinitely small, looking from the outside. All events of such a particle are their own for one observer from within. Since we do not see many of them, their world is short for us. For the inhabitant of this small "universe" the flicker to us is a whole eternity for them.

⁴⁵ Richard Feynman (1918-1988), American physicist.

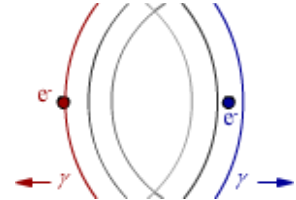
⁴⁶ I quote the book [2], text before the picture 1.26.

Quantum entanglement

A few questions run the previous image of Feynman's diagram, which has not been explained in his lessons⁴⁷ or in other physics textbooks. The first question is the virtual particle trajectory. The picture suggests that it is a line, but it can be shown⁴⁸ that this must be a sphere. The field of force around the particles with a charge forms the virtual waves surrounding it.

Namely, in order to induce the refusal of the electrons by the Coulomb's force (proportional to the charges and inverse proportional to the square distance between them), virtual photons cannot appear as bouncing ping-pong balls. However, the account will be accurate if we imagine γ as a virtual sphere

that extends from the center (each of) the electron e^- . Such virtual spheres, sketched in the figure on the right, encounter in uniform waves, but not necessarily each interacting with another electron. Interaction is a random event with chances that fall with the square of the distance of the electron, that is, with the surface of the sphere, which is independent of the intensity



and interaction. The physical quantities transmitted are exchanged if an interaction occurs.

Spin of electron can be a positive or negative half, and a spin of photon is a positive or negative unit. As well as the law of spin conservancies, in this transfer, not every value of photons is possible. For example, if the spin of the electron is on the left $+\frac{1}{2}$ and right $-\frac{1}{2}$, then the transition of the spin photons $+1$ from left to right is possible, after which the electron spin will be $-\frac{1}{2}$ left and $+\frac{1}{2}$ right. The next exchange of the same drift with the same type of photon is not possible, but it is possible in the opposite direction. Therefore, the positions of the shown electrons are a little asymmetrical.

The second question is how does the electron know about the interaction with a virtual photon? If the first electron changes the spin and interaction has not occurred, the law of conservancy of the total spin these system of three particles is violated, and vice versa, if the first electron does not change the spin and is changed by another. It is shown that similar harmonization of random events with the physics laws of conservation is a timeless and non-spatial process, which is called quantum entanglement.

The quantum entanglement was discovered by Einstein, Podolsky and Rosen in their⁴⁹ work in 1935, and this phenomenon is also called the APR paradox. They noted quantum entanglement as the inconsistency of quantum mechanics formalism with a "good" intuitive idea of the expansion of space effects. When two events are incidental, but also bound by some conservation law, then the measurement of the first is a random event, but the measurement of the other is not, no matter how large the distance is between the given events, and the time between the measurements is short. Einstein called this phenomenon "spooky action at a distance".

They observed measurements of the same phenomenon in different coordinate systems. We said that the observable, measurable values are the base vectors that span (unravel) the vector space. The defined vector space represents the observed quantum system with states that are vectors. By changing

⁴⁷ see [9]

⁴⁸ see [1], text with picture 1.14

⁴⁹ see [10]

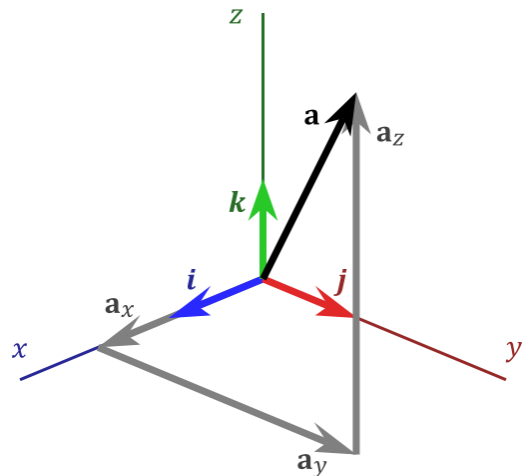
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the vector base, the vector does not change, but its relative relation to the coordinate axis changes. New axes represent new observable, and the projection, like the length of the shadow in the given direction, the vector adumbration on the given axis – defines the probability of finding the trait at the required state. The freedom to choose the base of the vector space, warranted by the theorems of algebra and functional analysis, confuses us in these applications.

Let us consider, for example, the decay of the radioactive particle of the total spin of zero. We have a quantum system and an initial state, in other words, we have defined the vector space and the initial vector. When on two opposite sides (due to momentum conservation), the two particles bounced, Alice and Bob, they have opposite spins (due to spin conservation). Measuring of Alice spin is a random event, but the next measurement on Bob is no longer such, it then shows the exact opposite value to the first.

Visualization of the quantum state is in the right figure. We have a three interesting observables that we measure and represent by x , y , and z axis (abscise, ordinate and applicate) of the right-hand Cartesian coordinate system. The unit vectors, respectively \mathbf{i} , \mathbf{j} and \mathbf{k} , we call orths (orthonormal basis). This is a framework for a modest quantum system. It is modest because usually there are many more base axes, and calculations are done with complex numbers.

The vector \mathbf{a} is a quantum state. Vertical projections of \mathbf{a} on the axes are lengths a_x , a_y and a_z , and the products of these with the corresponding orths are the gray vectors in the figure. It is clear that the rotations of the coordinate system change the projections of the same quantum state on the new axes. The probability of observation of the property increases with the square of the projection length.



Since every (isometric) coordinate transformation can be obtained by rotations, so the evolutions of quantum states are some kind of rotations. Let's move it now to the aforementioned breakdown of the radioactive particle. The occurrence of Alice's spin measurements is proven by repeating the experiment in the same conditions, when the outcome behaves like the outcome of the coin throw. However, individual measurement is the communication of a measuring device with a measuring object. By submitting information, the object reduces its uncertainty (for example, the path is better defined), and vice versa occurs by downloading information. Each of the two directions of communication formally represents some rotation of the coordinate system, and they eventually (often) do not return the system to the initial position. Therefore, the next measurement of Bob's spin does not find the earlier expected coincidence. Measurement of the first particle will exhaust a certain type of uncertainty of the given pair, and the next measurement will indicate certainty on the other.

Therefore, quantum entanglement occurs with dependent random events. This is nothing unusual in the theory of probability, but it has not been noticed at one time. For decades, after the discovery of the APR paradox, physicists took over the author's initial explanations that the application of current

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mathematics in quantum mechanics is incorrect, that the form is wrongly placed and that some hidden parameters exist in the processes of quantum entanglement. These views did not change for a long time not even after Bell's⁵⁰ work⁵¹ published in 1964, in which he proved the contradiction of the assumption of the hidden parameters. Quantum entanglement was seen as proof that the mathematics of quantum mechanics was not well chosen, and that same story is persistently rewritten in the textbooks of physics, until the first experiments.

In accordance with (my) previous explanation of quantum entanglement by rotating the coordinate system, Bell's proof, which is rarely understandable, becomes a little clearer. Simply put, the requirement to remove quantum coupling would be a requirement that the theorem on the freedom of choosing the coordinate system does not apply. This would be a particular insisting that it is not possible from the given system ($Oxyz$) to switch to another, also the right-hand Cartesian coordinate system ($Ox'y'z'$), and this would lead the vectors algebra in contradiction.



After the first experiments and regular confirmation of quantum entanglement, we realized that Einstein was stepping to the solution of this mystery. He described conditional events with a pair of gloves, left and right, positioned in two identical boxes and sent to two sides of the world (picture above). When someone in New York gets one of those boxes and does not know which of the two gloves is inside, he does not know exactly what's in that other box. However, by opening his box and finding that in it is the right glove, he also finds that in the second box is the left.

Similar attachments of random events with certainty cause quantum entanglement. From timeless and nonspatial mathematics, we have this in combination with the laws of conservation of the total spin and freedom of spins of individual particles. Also it comes from the conservancy laws and free interactions of a virtual photon with another electron, from the example at the beginning of this subheading.

⁵⁰ John Stewart Bell (1928-1990), North Irish theoretical physicist.

⁵¹ see [11]

Waves interference

Now we will see that this common word, interference, is physically inadvertently chosen. It should not be interpreted as the interaction of waves, but as an observation of the intensification, weakening or canceling of two or more waves by an external observer. It's subtle, but has a big consequence. Individuality of participants, waves (particles) in interference, is preserved. They do not interact with each other.

In the previous Feynman diagram and interaction of virtual spheres, we add the following on right, where we see the field that forms two electrons of total charge $q = -2e$, that is, twice the stronger than the ones discussed there. The Coulomb force of this particle is twice as strong, and some fields of the electron interfere and do not lose their individual traits.

Similar preservation of the special features of each of the visible light from the spectrum is in the white light, which is proved by the same experiments that Newton described in his Optics⁵² from 1704. Passing the white light through the prism gives a spectrum of colors, and it released further through the second prism gives the white light again.

This means that the photons do not interact with each other! Their occurrences at given places at given moments are independent random events. Like other bodies that move gradually, without big jumps, because such a change in (relative) likelihood by the action of the force around them, photons glide over the space in the waves. We said that this periodicity as well as coincidence is a consequence of the principle of the finiteness of matter. This does not apply to abstract world of truth.



The mathematical truths generally are not random events, they are not necessarily final terms, nor are they bound by space and time. Time is not a mathematical term, and when mentioning "space" is not meant for physical one. On the other hand, all the physical properties of matter come from abstractions, and especially independent random events. It can be proven⁵³ that random events are dependent if and only if they are excluded. This theorem of probability theory has incredible consequences that may have remained unnoticed in contemporary physics. Let's see how they change the look at the "double slit" experiment we mentioned earlier⁵⁴.

Details⁵⁵ of this thesis can be found in the book "Quantum Mechanics" and some of my earlier texts (not in official physics), and now I'm just sketching the main one. The method of summation of the amplitudes of the outcomes, the waves passing through the double slit, compared with Born rule (on

⁵² see [12]

⁵³ see [1], Theorem 1.1.47.

⁵⁴ in the subtitle Uncertainty

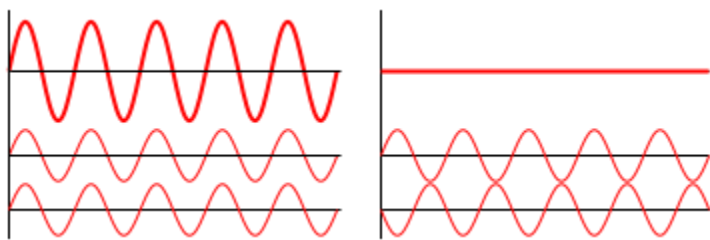
⁵⁵ see [1], text with picture 1.26.

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probabilities expressed by amplitudes) does not show independence. I repeat, the sum of the state vectors input that produce interference, registered on a curtain behind the slit in the form of diffraction light-dark strips, is inconsistent with the probability formula of union (sum) of random events. Consistently to mentioned theorem, interfering waves represent random events whose intersection has a probability different from zero. Simply say, in the given place today is possible the joint manifestation of the waves that have passed here a long time ago and could interfere.

This wave independence that permits their interference and the consequence that they participate in some common random events now, although long ago appeared in a given place, means that the vacuum is an interference of all past waves. If we do not observe some light in a vacuum, it's because all of the last light was in balance, they were canceled, and the overall result is their so-called destruction. Where we see photons, there is a disturbance, excess, so-called constructive interference.

In the following figure, the lower two waves interfere in the upper one; constructive and destructive



interference. The first two in increased amplitude, the other two in canceled. If in some space we generate many of these waves in a random way, and then collect (integral) all their amplitudes, we would get a wave or a straight line. In the first case we could say that we have

a photon (particle), in the second we do not have it.

This explanation is in line with the understanding of matter as part of the abstract world of truth, and also with our interpretation of the vacuum. Now it's easy to recognize that it is in line with the experiment "double slit". Namely, passing through the wave-particles one at a time through the two openings, as it is known, in the longer time intervals, the same light-dark diffraction lines appear on the curtain behind, as when all these waves are released at once.

Interference synchronizes past events with the present, as we have in the case of quantum entanglement. A third example is the Schrödinger's cat. An imaginary cat in a box simulates a quantum event. The cat is alive or dead depending on a coincidence from a recent past, and we do not know the result – until we open the box. When we open the box and find that the cat is alive or dead, it will mean that the random incident is or is not killed it. Moreover, if we had real uncertainty before the opening of the box, as in the random events of the quantum world, then our new knowledge will also be defined by a corresponding event from the past. This information from the present changes the past!

In their Copenhagen discussions from 1925 to 1927, the founders of quantum mechanics Bohr⁵⁶ and Heisenberg developed an analogous interpretation of quantum mechanics. Quantum systems, in general, do not have definite properties before measurement, and quantum mechanics only predicts the probability that the required results will appear in the given measurements. The measurement process affects the system and reduces the probability to only one of the possible values, immediately

⁵⁶ Niels Bohr (1885-1962), Danish physicist.

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after measurement. This property is called a state vector collapse, i.e. wave functions. The theory I put out supports them, but it does not follow their interpretations of the reality.

Observers are all participants of reality. These are particles that can interact, or communicate. The more observers the system can last for longer, because the available uncertainties are greater, and their spending, the emission of information last longer. Therefore, in the enormous content of the universe, the perception or non-perception of one subject can be negligible consumption of its uncertainty, and it lasts and lasts. On the contrary, the inability of a (real) perception of a virtual particle indicates the absence of its (real) uncertainty and makes its life very short. Vacuum rocks with virtual particles, whose product of energy and the period of life is no greater than Planck's constant, and we only find out them indirectly, they are pseudo-particles for us. When the energy of such infinities becomes infinitely small, their duration becomes infinitely long; such "particles" become similar to theorems of mathematics.

Nature hides the truth, but it cannot hide all. In short, after interference and seemingly canceling, all the wave-particles of the past are now and there is a way to notice them. And one of these methods is hidden in the discovery of dark matter. I recall, working at the California Institute of Technology and studying the galactic clouds, in 1933, Zwicky⁵⁷ discovered that there was not enough visible matter that could be attributed to the intensity of the gravitational field within and between the galaxies. The galaxies are turning too fast regarding their mass!

As a glider on the ice when it starts to rotate in place and shrinking hands accelerates, similarly, the galaxy rotation around the center synchronizes with its mass. The speed of the rotation of a part of the galaxy depends on the distance from the center and the surrounding mass as Kepler⁵⁸ explained.



During the seventies and eighties of the last century Zwicky's deficit (even 90%) of matter was confirmed by other galaxies. This knowledge gave birth to the idea that the missing material is not "normal", but a special, some unknown "dark matter". The theory of "dark matter" was initially poorly accepted, but today it forms part of modern cosmology, although its origin is not known. The word "origin" could be the key here. In this case, the way of discovering the dark matter of cosmology and the interference of all past waves will be similar; because in the interference of particles there is no interaction.

⁵⁷ Fritz Zwicky (1898-1974), Swiss astronomer.

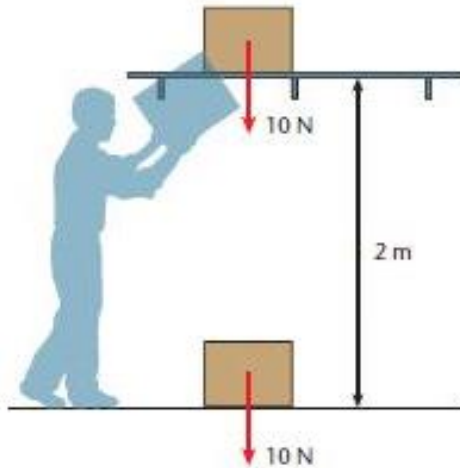
⁵⁸ Johannes Kepler (1571-1630), German mathematician.

Force

We will see that there are different definitions of force that are reduced to the same in classical physics, but not in relativistic ones. We can look at this similarly to the merging of wave and particle properties into the micro-world dualism, when in the macro-world we have distinct differences between waves and physical bodies. The theory of the relativity its own differences in the notion of force ignores simply because it follows only the one that reduces it to geometry. But we need other forces because of the principle of probability.

Let's observe the two coordinate systems in the uniform straight-line motion, where the second moves in relation to the first by the constant velocity \mathbf{v} of speed v . When the two systems are right-handed, the Cartesian whose axes in the initial moment ($t = 0$) match, and the movement takes place along their abscissa, then we can use the marks and results from the subheading "Entropy". This means that proper values (observer at rest) are still labeled by index zero, and the respectively relative (seen in motion) without that index.

One of the simplest and most commonly used formulas for the energy and force is $E = \mathbf{F} \cdot \mathbf{r}$ where the left of equality is a scalar (number) that denotes energy or work, and to the right is the scalar product of the force and position vectors. It defines the "work of force on the road". We meet it everywhere.



For example, in the picture on the left, we see lifting a load of 10 N (kilogram of mass) from floor to shelf, at a height of 2 m. The work $10 \text{ N} \times 2 \text{ m} = 20 \text{ J}$ has overcome the force of gravity. It is equal to the increase in the gravitational potential energy of the given load. In other words, 20 joules are energy consumed to raise weight, weighing 10 Newton, to a height of 2 meters.

Let's go back to Feynman's diagram, the subtitle "Universe", and watch the interaction of the particles in motion at a given moment. The energy transferred by the virtual photon between the electrons denote by the infinitesimal scalar dE , the electron rejecting force generated by it denote by the vector \mathbf{F} , and the change in the position of the electron caused by the photon with the infinitesimal vector $d\mathbf{r}$. Energy is equal to the spent work of force on the road, therefore $dE = \mathbf{F} \cdot d\mathbf{r}$. We distinguish two cases, when the distance between the electron is perpendicular to the direction of motion (index \perp) and when both electrons are in the same direction (mark \parallel).

When the motion of an electron is perpendicular to the direction of the motion of the system we observe, there are no relativistic changes, so we can write $F_{\perp} = F_0$ where on the left side of equality is the component of the force perpendicular to the direction of motion, and on the right is its proper force, which we would see moving jointly with the system. When the motion of an electron moves towards the direction of the system, then we get $F_{\parallel} = F_0 \gamma^2$ where the component of force on the left side of the equation is parallel to the movement of the system.

Virtual photons create an electromagnetic field and with it the force that drives electrons. They further change the positions and directions of movement, and the components listed should then be combined. These are more complex calculations that we skip here. It is important that we have grasped the point that the relative force parallel to the movement is growing with the square of the slowing of time (γ^2), and the force perpendicular to the direction of movement remains unchanged.

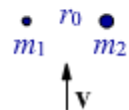
It looks simple, but it's not. The result obtained is not the same as that which follows the derivation directly from Lorentz transformation⁵⁹. The question is why? First of all, because Lorentz's transformations are valid in the inertial systems of the special theory of relativity, and they are no longer valid as is the force in count. Transformation of such a force is invariant on Lorentz transformation, so we rotate in the virtuous circle.

Secondly, in Newton's mechanics, force is a product of mass and acceleration ($m\mathbf{a}$), but the force is equal also to the change of momentum in the unit of time ($\frac{d}{dt}\mathbf{p}$). However, in the mechanics of the special theory of relativity these two forces are no longer equal. The derivative of the time of known relativistic relations $E = mc^2$ and $E^2 - p^2c^2 = m_0^2c^4$, which are mostly used instead of Lorentz transformations, after updating⁶⁰ we find $m\mathbf{a} = \mathbf{F}_{\parallel} / \gamma^2 + \mathbf{F}_{\perp}$. The relative force component \mathbf{F}_{\parallel} parallel to the velocity (direction) of the system movement grow proportionally with γ^2 , while the vertical component to the velocity \mathbf{F}_{\perp} remains unchanged. When $\mathbf{F}_0 = m\mathbf{a}$ proclaiming it as "own force" we get the agreement with our previous computation.

That this "proclamation" is not without foundation will be noticed when the calculation for the Feynman diagram is applied to two bodies of relative masses m_1 and m_2 which gravitationally attract. The sketch on the right shows the position of the two bodies that we (inertial) approach when the drawing line is vertical to the direction of motion (down), and the other when it is parallel (above).



In the first case there is no contraction of length, so the relative distance of the body is equal to its proper. In the second case is $r = r_0\gamma$. In both cases the masses ($m = m_0\gamma$) are relative. Gravitation attracts the bodies by force proportional to the masses and inversely proportional to the square of their distance. When we declare the lower force as "own", index zero, then we have down $F_{\perp} = F_0$, and up $F_{\parallel} = F_0\gamma^2$. This is not the "work of force on the road" and the result is a little different, but in a way similar. It is different for the relative masses of the forces, vertical and parallel, which in the case of charge is not. Let's look at this in the next thought experiment⁶¹.



Let's look at two wagons A and B moving in the opposite directions and the embankment C in relation to which these speeds are constant $\pm v$. The space between the wagons at the time of passing is open and they are very close, so the air can freely move from one to the other. From the fluid dynamics, we take

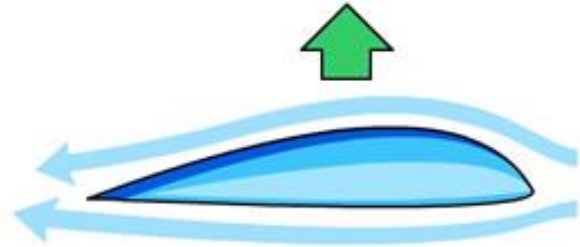
⁵⁹ see [13]

⁶⁰ see [2], formula (1.39)

⁶¹ see [2], Figure 1.25.

Bernoulli's⁶² equation ($\frac{1}{2}\rho v^2 + P = \text{const}$, where ρ the density of the fluid is, v is speed, and P pressure), due to which we know that the jet of a fluid (gas or liquid) sucks particles from its environment by pressing it with the square of its velocity.

In the image of an airplane wing, we see the main reason for the rise, which is the result of Bernoulli's equation. The higher the airplane speed to the right, the faster flows air around the wing, but due to the shape, the higher is the speed on top. The upper air sucks the wing stronger and the plane gets buoyed. With the given shape and wing size there is an optimal speed and flight height of the plane, when these forces are in balance.



Transferred to our example with wagons, we will have three views, three observers, concerning the special theory of relativity. From the point of view of the observer A, who is stationary in the first wagon and because of the relativity of movement, only the other wagon can be considered as moving. The air of this wagon is a suction fluid, which should cause air flow $A \rightarrow B$. From the point of view of B observer in his wagon, for the same reason, the opposite motion $B \rightarrow A$ happened. From the viewpoint of the observers C, who sees it all from the embankment, both wagons move equally, for each is equally valid the Bernoulli equation, so there is no passage of air. What is the problem?

The point is that in this story we did not take into account relativistic pressure changes. Pressure is a force and area coefficient $\mathbf{P} = \mathbf{F} / \mu$, where μ is the area on which the force \mathbf{F} acts. Pressure and force I deliberately write as vectors, because their relative values in different directions are not equal, even if their intensities are. The relative contraction of the lengths exist only along the wagon, so the relative air pressures in the wagon, forward-backward and left-right in relation to the direction of movement, are respectively $P_{\parallel} = P_0 \gamma^2$ and $P_{\perp} = P_0 \gamma$, where the zero index marked the own pressure, which is uniform in all directions.

This lateral pressure must be exactly equal to the suction due to fluid motion, which means that the other equation is Bernoulli's! This is, of course, a novelty for physics, so I emphasize it. We obtained an improvement in the Bernoulli equation, similar to a relativistic formula, say for increasing the total energy that is the improvement of the kinetic energy formula.

The same formulas for force transformation can be applied to the expansion of the universe. The fact that we have uncertainty in the universe, that is, probability, means that we have to have forces. Therefore, in the case of a homogeneous space (after the Big Bang) it is duly to assume the existence of a thrust in all its points, which is stretching and functioning today. The galaxies are removed inert, so this force, if constant, grows with a square of the time-delay coefficient. So the galaxies are accelerating relatively. We see the past and the faster departure from the imaginary center of the explosion, which is in all directions from us (if there are no other forces). The elaboration of this idea would go towards the explanation of the so-called dark energy, the recent discovery of cosmology.

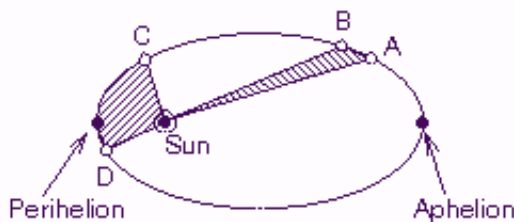
⁶² Daniel Bernoulli (1700-1782), Swiss mathematician.

Gravitation

Here I am talking a bit about the development of the idea of gravity of the last centuries and the problems that tormented me with it. Believe it or not, but it was about my first expectations in the work on physical information and probability.

There is no way that you will mix determinism and coincidence – my colleague persuaded me – water and oil do not intermix. Or is it determinism or not, man, and it is not because of heavenly mechanics! And much better than you broke your teeth on that walnut – he paused to sigh – on that rampage of determinism. My other conversations about these topics were also tense during the last decade.

And somewhere at that time I spent my confidence in mathematics looking for a deeper understanding



of Kepler's and Newton's laws. The first Kepler's law, I recall, is about the ellipses of the orbits of the planet with the Sun in the focus. His second law claims that the lines connecting the planet to the Sun cross the same surface at equal intervals of time, as a hollow area from A to B or from C to D in the figure on the left. The third law says that the square of the starry period (sunrise time) of each of

these planets is proportional to the cube of a large half-length of its ellipse ... But, when I think about it, you can skip these passages too.

If you are looking at a small path of the planet, from a point A to B and hatched surface μ , angle SAB is say α , distance from the Sun to A is \mathbf{r} , and distance from A to B is $d\mathbf{r}$. Hatched area is infinitesimal scalar $\frac{1}{2} r dr \sin \alpha$, but it is also the intensity of oriented area, the vector product of the vectors

$d\mu = \frac{1}{2} \mathbf{r} \times d\mathbf{r}$. Derivation on time gives $\dot{\mu} = \frac{1}{2} \mathbf{r} \times d\dot{\mathbf{r}}$. Derivate again on time and get $\ddot{\mu} = \frac{1}{2} (\dot{\mathbf{r}} \times \dot{\mathbf{r}} + \mathbf{r} \times \ddot{\mathbf{r}})$. The first summand on the right in brackets is zero because the vector product of

the parallel vector is zero. In the second summand the vector $\ddot{\mathbf{r}}$ is planet acceleration, and according Newton's second law it is proportional to gravity force, so it has the same direction as \mathbf{r} . For that the second summand is zero. So, $\ddot{\eta} = 0$, hence $\dot{\mu} = \text{const.}$ the Second Kepler Law.

The first Newton's law speaks of inertia: "Every body remains in a state of relative rest or even straight line motion until the action of another body or force." The second Newton's law speaks of the force: "Acceleration of the body is proportional to the force acting on it, and inverse proportional to the body mass." The third is the law of action and reaction: "The force with which one body acts on the other body is equal in intensity and direction to the force by which the other body acts on the first one, but it is the opposite direction." For each action force that acts on a body, there is a reaction force.

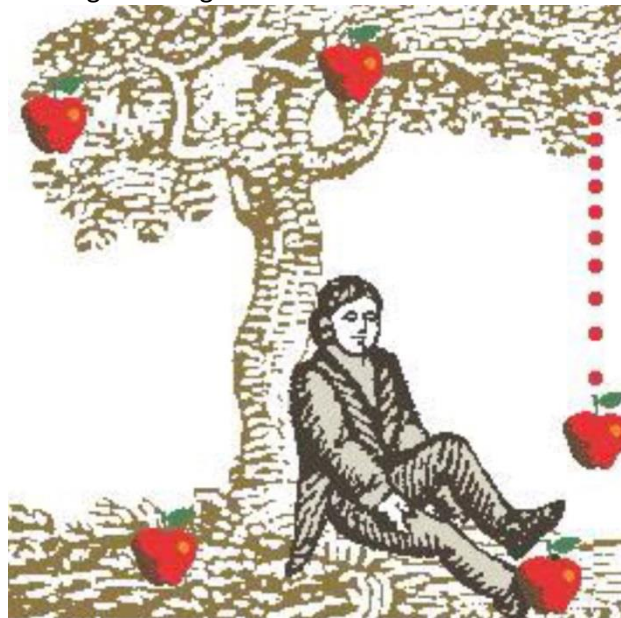
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I ran around these sentences looking for something, even if I did not know what. However, who does not search for it does not find it! The forces gladly hatch constant surfaces like Kepler's, and I noticed that the consistency of these surfaces also means the presence of force. It means minimalism in energy consumption, minimalism of action, and then minimalism of communication! I later entertained by the surfaces, for example, the polygons with the "commutator", as I called the second order determinants from the development of the surface of the triangle (see [15]). I neglected the information.

It is not that I did not notice that the same commutators contained the differences between the two Lagrangians (known terms for the principle of the smallest action of physics) or that the same Lagrangian defines a measure of the quantity of options that the body has, but I did not know what to do with them.

If a gas container is in a satellite that circulates around the Earth, it is in a weightlessness state and gas molecules are distributed uniformly, but if this vessel is on the surface of the Earth, gravity pulls the molecules and they are denser to the bottom. I found this to be a clear proof that the gravitational force changes the probability and that a probability distortion could mean the presence of some force. But one thing is need it now, the other is to know how! Quantum mechanics works with probabilities defined by wave amplitudes, and those looks as they are immune to gravity. That's why I paid attention to wavelengths, looking at them with the eyes of de Broglie and Heisenberg once, as the "smudging" of the particle, its "indeterminacy" of the position and, therefore, the density of probability.

Calculating changes in the potential energy of bodies moving around gravitational fields can be found in many places and in my book Space-time. There⁶³ you also have an interesting evaluation of the mass $m = m_0\gamma$, of bodies falling in the gravitational field. The mass m_0 would have this body out of the gravitational field. With this mass there is $\gamma = \exp(GM/rc^2)$ the coefficient that developing in series and neglecting higher degrees becomes equal with the corresponding relativistic, known from the Einstein theory of gravity. It is equivalent to Lorentz's coefficient of the same name. The number $G \approx 6,67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$ is the gravitational constant, M the mass of the planet or the star to which the body falls, r the distance of the body from the center of gravity, $c \approx 3 \times 10^8 \text{ m/s}$ the speed of light in vacuum.



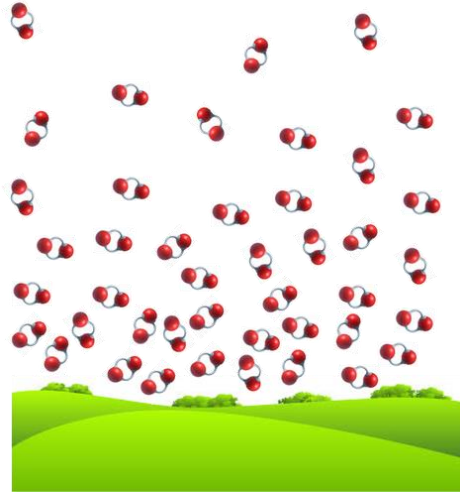
An increase in the mass of a given body is interpreted by an increase in inertia due to a slowdown of time, which means that time in the gravitational field slows down with the same coefficient ($\Delta t = \Delta t_0\gamma$), and then we have a great analogy with the formulas listed in the subheading "Entropy". That it can be, the following consideration is confirmation.

⁶³ see [2], formula (1.124) and further

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The increase in mass is due to the increase in total energy, in the same way $E = E_0\gamma$, due to the increase in kinetic energy, by increasing the speed in free fall. The same applies to all wave-particles, so the light that comes from the star⁶⁴ has a frequency $f = f_0 / \gamma$, where its frequency f_0 is out of gravity. Since the number n of blinks in the unit of time is inverse proportional to the duration of a single blink $n \cdot \Delta t = \text{const}$, and we get again $\Delta t = \Delta t_0 \gamma$ the expression equal to the previous one. Gravitation slows down time!

The appropriate wavelength⁶⁵ is $\lambda = \lambda_0 \gamma$. It is larger in a stronger gravitational field of the star, so there



are also less the probability densities (defined by wavelength). I consider these probabilities relevant to gravity, so we encounter one paradox. The lower probability provides more information whose production defines time. More information produced means a faster flow of time! Hence the paradox.

It has been mentioned earlier that the solution to this problem is the departure of a part of the present into a parallel reality. Gravitation of general theory also spends information as well as relative systems of special theory, and there, in the same way as before, there is no contradiction.

In the gravitational field, the denser air is closer to the floor of the room, and so the observer who stays away from the field, or freely falls in the field, sees it as an entropy disturbance. Therefore, the body in free fall will not spontaneously stop, because it will not spontaneously go into the state of less entropy. This is by the interpretation of entropy in Boltzmann's way. And according to the entropy of Clausius, the heat energy and temperature ratios, this is obtained as follows. The free fall only increases the kinetic energy of the body, without changing heat, but increases the body temperature⁶⁶ (I'm not thinking of friction here). A red shift is testified to the increase in body temperature, otherwise known from Einstein's theory.

Geodesic lines are the spatial-time paths of spontaneous motion of bodies in a gravitational field that can be obtained by solving Einstein's field equations, but can also be obtained by monitoring the optimal probabilities that generate gravity in space-time. Both are equally approximated by Newton's and Kepler's paths (ellipses, parabolas and hyperbolas), and this is not strange in mathematics. We also know more hundreds of the proofs of the same Pythagorean theorem, so why not have so many exact ways to get the same geodesy. In the end, we note that somewhere at the beginning of this book is said more than that, that nature can really mix water and oil. She likes diversity.

⁶⁴ due to Planck's quantum formula $E = hf$

⁶⁵ due to $\lambda f = c$

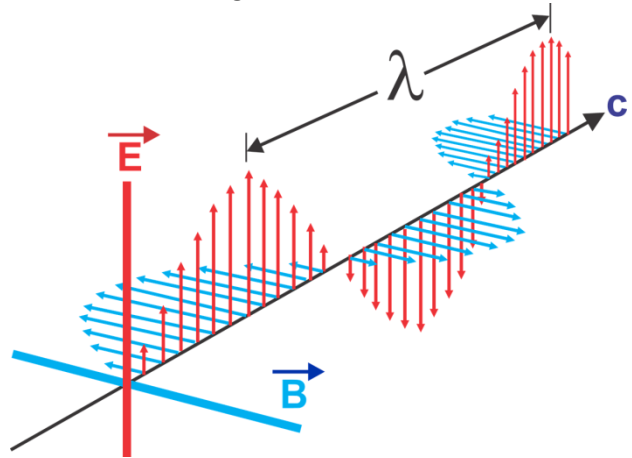
⁶⁶ My (hypo) thesis from the previous texts.

Electromagnetism

As long as the longitudinal (parallel to the direction of motion) properties of light are important for understanding gravity, so many are its transversal (vertical) properties important for understanding electromagnetic phenomena. Let's look at them, in the order from the most famous.

Amplitudes

In the figure on the right we see a photon, a wave-particle of electromagnetic radiation, in the movement along abscissa by speed c in the rectangular system $Oxyz$. The electric field \mathbf{E} amplitudes periodically grow and fall along the ordinate, and the amplitudes of the magnetic field \mathbf{B} along the applicate. One shift of these values, electric and magnetic fields, occurs on the path of one wavelength λ . The plane Oyz rotates around abscissa.



Unlike wavelengths that do not change with the expansion of the sphere, the amplitudes are reduced. We see this in the formation of a wave of water over the surface, also, which slowly calm down by increasing the circle of the front, with the vertical oscillations becoming less and the lengths of their periods do not change.



Wavelengths determine the probability of a path in the gravitational field⁶⁷, and the amplitudes determine the probability of interaction. These are two different types of probability, of which the latter in quantum physics is governed by Born's⁶⁸ law. The expansion of the sphere of virtual photons around the first electron reduces its amplitude (electromagnetic field), and with them the chance of interaction with another electron. It is not a coincidence that these amplitudes decrease with distance, and the surface with the square of spatial distance, it is proportional to the reduction of Born's probability of interaction. The energy, momentum, spin and similar of photons do not change, and in the case of interaction, these are physical properties that are transferred to another electron.

⁶⁷ My (hypo) thesis from the previous texts.

⁶⁸ Max Born (1882-1970), German mathematician.

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When the rotational speed of the Oyz plane around axis x is zero, the light in the previous picture, then we say that it is polarized in the direction of the electric field. All such waves vibrate at Oxy level. Polarizers that contain a grid through which polarized light passes are filters of long chained polymer-oriented molecules in one direction. Only the incident light that vibrates the parallel orientation of the polymer passes, while the light of the vertical vibrations is absorbed. Natural light, such as the sun, is not polarized. The amplitude of the electric field takes various directions, always point to the direction of motion of light and to the direction of the magnetic amplitude. By refraining from the water surface, unpolarized light is partially polarized.

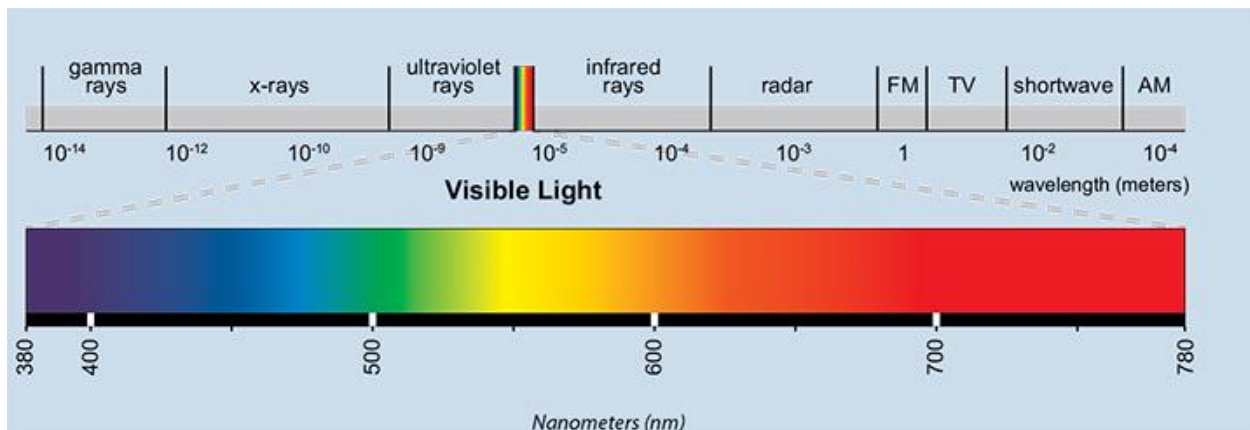
Wavelengths

The wavelength of light determines its color; the red is longest, purple the shortest. In the picture on the



left we see how the white light breaks through the glass prism and dissipates into the free colors, from the bottom up in the order, according to the growing wavelength: in violet, blue, green, yellow, ocher and red. The straight path of the purple light movement, with the shortest wavelength, turns most. The shortest wavelengths react with the glass most and slow

down most. Visible light is just an insignificant part of the spectrum of electromagnetic radiation, in the following figure, arranged from left to right in the growing wavelengths. All of them apply the same rules of refraction and reflection.

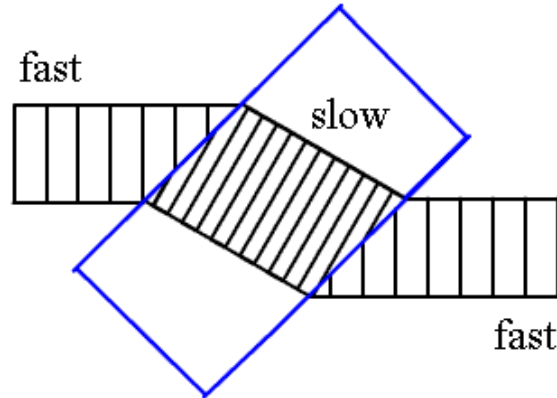


Since all phases of the amplitude are at one wavelength, this is the energy of the electromagnetic waves proportional to the number of these phases in the unit of time (f -frequency), that is, it is inversely proportional to the wavelength. The smallest energy of free radiation is quantum (hf), for which Plank⁶⁹ discovered that it depends only on the frequency.

⁶⁹ Max Planck (1858-1947), German theoretical physicist.

Reflection and refraction

When they move from the environment in which they move faster in the medium in which they move slower, the waves are refracting toward the normal on the border of environments. This can be demonstrated by soldiers (students) arranged in rows with equal distance between them that are allowed to march across a border of two different environments, as in the figure on the right. Like photons that interfere, which means they do not interact, the marching soldiers do not have to hold on hands. You can find more about this [16].



In general, if v_1 and v_2 are the speeds of the wave in the two environments, and the angles of the incident and the outgoing rays to the normal at the border of the mediums are α_1 and α_2 respectively, then $v_1 : v_2 = \sin \alpha_1 : \sin \alpha_2$. It is Snell's law of kinematics, which also follows from the principle of least effect. The smallest possible time is needed to wave for passing the path with given speeds.

The law of the smallest action can also give the law of reflection of the wave. In the picture on the left, the wave goes from point A to point B , reflecting from the line p . It is reflected in point C and not in point D , because the length $A'C-B$ is shorter than the $A'D-B$. Namely, AC is equal to $A'C$, as well as AD with $A'D$, because they are axial symmetries, that is, mapping that does not change the distance (isometry). Therefore, the angles α and α' of incidence are equal, and are equal to the reflective angle β . You can also get the same as the shortest trip time at a constant wave speed: the angle of incidence is equal to the reflecting angle. In the standard particle model, that would be the end of this story.

In physics of particles, the gauge boson is the carrier of force, the transmitter of some of the fundamental interactions (gravitational, electromagnetic, weak and strong) in the manner described in the Feynman diagram. In the standard model, three types of gauge bosons are known: photons, W and Z bosons, and gluons. Each of them is responsible for one interaction: photons are the gauge bosons of the electromagnetic force, W and Z bosons transmit weak nuclear force and gluons a strong nuclear force. They all have spin 1, and therefore are vector bosons. For gravity, it is also assumed that it could be transmitted by a hypothetical gauge boson called the graviton of spin 2.

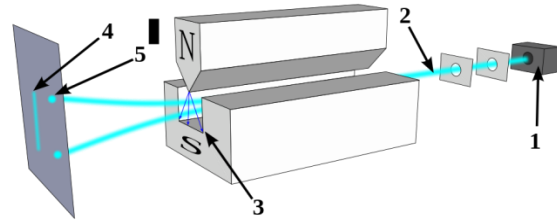
If the gauge boson of spin 1 had a mass, it would have three polarization modes (two transverse and one longitudinal), and if it is devoid of mass it had only two transverse polarities, it is considered, as we have described here the photon. Accordingly, we assumed that the photons are the massless particles. However, there are and different views (see [17]).

If we observe a photon as a particle with mass, it could be rejected like an asymmetric ball, so that the incident angle is not equal to the reflection. There are experiments that confirm this (see [18]), so we will consider this too. Before that, let's look at what spin is in the way it's discovered.

Spin

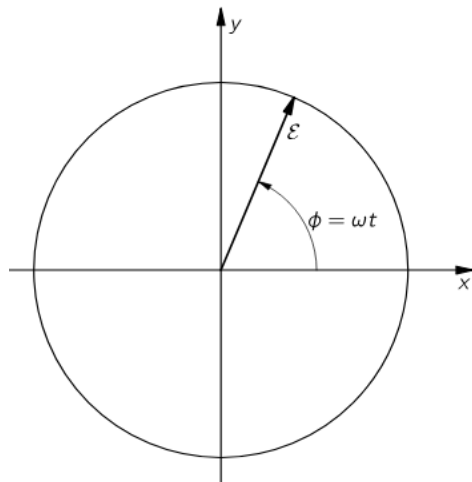
Spin is a basic feature of elementary particles, such as mass and charge, and is interpreted as an internal moment of the momentum, more freely speaking, as a small gyroscope. Spin has a dimension of action and is expressed as a multiplicity of (spin quantum) number and a reduced Planck constant $\hbar = h/2\pi$, with two values \pm . Particles with an integer spin quantum number are bosons, and with half integer are fermions. In addition to elementary particles, a more complex can also have a spin, for example, an atomic nucleus when it comes to a nuclear spin that is the sum of the combinations of the spin of the protons and neutrons from which the nucleus is made.

Spin interacts with the magnetic field and influences the motion of the electron, so it was discovered in 1922 in the Stern–Gerlach experiment. By measuring the magnetic dipole moment of the silver atoms when passing through the inhomogeneous magnetic field, the splitting of the beam of ionized atoms into two rays was observed. It was observed that the beam splits into $2l+1$ parts, where l is the orbital quantum number. A similar experiment with the hydrogen atom was repeated in 1927 and again the same splitting of the beam was obtained. The only explanation for this feature was that the electron beside the orbital momentum of the momentum has an additional internal angular momentum called a spin.



In the image of the Stern-Gerlach⁷⁰ experiment, right, silver atoms pass through a non-homogeneity magnetic field and separate up and down depending on their spin. The marks are: 1 – furnace, 2 – ray of silver atoms, 3 – non-homogeneous magnetic field, 4 – expected result, 5 – observed result.

In his Lessons⁷¹, Feynman observed polarized light in a rotating system for the angle ϕ around z -axis. As shown on the left, this rotation is obtained by multiplying the complex number $\exp(i\phi)$. He (accurate) concludes that this means that the photons of light that are right circularly polarized carry some single angular momentum along the z -axis. Also, if we have a ray of light with a large number of photons, each circularly polarized in the same way; it will have a collective angular momentum.



Feynman further calculates, when the total energy of the rays for some time is W , then there is $N = W/\hbar\omega$ photons there. Each of them carries an angular momentum \hbar , so the total angular momentum is $J_z = N\hbar = W/\omega$. He further concludes that classical physics of light could have evidence

that such polarization has energy and an angular momentum proportional to J_z .

⁷⁰ Wikipedia: Stern–Gerlach experiment

⁷¹ see [9], Book III, Ch17–4 Polarized light

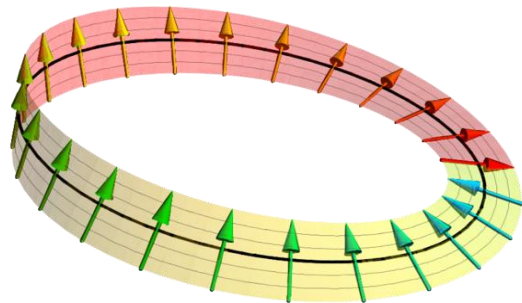
Double rotation

Let's go back to the upper picture of the $Oxyz$ system and notice that there is asymmetry in the motion of the amplitude during one wavelength. Let's look at the circles (sinusoids) by which electric and magnetic amplitudes move. At Oxy level, the electric amplitude moves from O to the upper semicircle, and the magnetic is tracked as a shadow in its right hemisphere. It encounters half wavelengths and the electric continues, it falls into its lower semicircle, and the magnetic goes to the left semi-circular Oxz . When they meet again, at one wavelength, one cycle ends.

However, the question is whether nature in general respects this exclusivity in the up-down and left-right orientations. If not, when we study the movement of these amplitudes in the medium (statistical), in general mixed states, then we must account the both orientations. We need to include a tour of not just one but two circles. Rotations of these amplitudes should be observed not for 360° but 720° .

When it would be possible to stop the photon or connect the upper coordinate system to it, then the amplitude of the electric field would circle in the plane Oxy the circle diameter from O to half the wavelength, where it would meet magnetic amplitude that travels an equal circle in the vertical Oxz plane. Then, each one, each on its circle, would return back to point O . It would also be a full wavelength, but half of its possibilities. Of course, the photon does not stop; it always goes by the speed of light, so this picture is just a thought.

Both explanations, I hope, help to understand one of the long-known but persistently bewildering spin features of quantum particles. The spin vector is perpendicular to the imaginary plane rotation. This plane here is equal to the electric amplitude, and the spin has the z -axis direction. However, unlike other vectors, the spin should be rotated twice to reach the initial position. See proof in my book⁷².



The picture on the right is the Möbius strip. We'll get it from an ordinary band that we connect in the opposite direction. If the Möbius tape is traversed by a transversal vector as in the picture, only after two full circuits (720°), after traversing both sides of the ordinary tape, this vector enters the initial position.

Mass of photon

If the photon has no mass, how does it feel the effects of gravity? This is one of the confusing issues of astronomy. Considering that the photon does not have a resting mass, today we take Newton's theory of gravity as approximate, and Einstein's general theory for its improvement. According to this new theory, gravity is not a force! It is a consequence of changes in the geometry of space caused by the presence of mass. Geometrically interpreted, the light does not come out of the black hole, not only because of its large mass, but also because there is no way.

⁷² see [1], with Figure 1.42: Dirac tape

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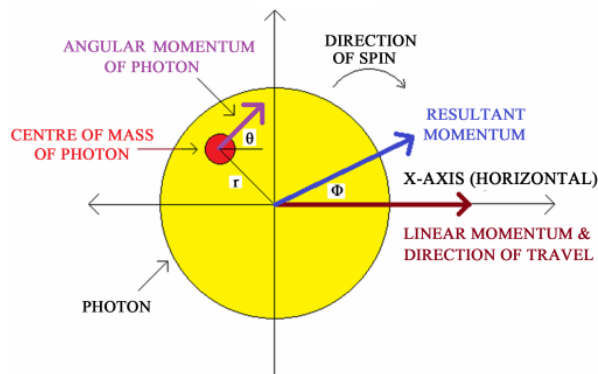
Looking more carefully, because of the same theory of relativity from which we have a formula $E = mc^2$ that connects energy $E = hf$ with the mass m and speed of light c of each particle, and even photons, we consider that photon has a mass in motion, but it is so small that it is neglected. The mass of slower movement would have been even smaller if the photon could be stopped, so we would ignore it even more.

Less direct approach to the same problem is the observation of the reflection of light, which I mentioned above. If the light reflects as an asymmetrical ball, so that the incident angle is not equally reflective, then it can be assumed that this is due to the asymmetric mass of the photon. However, light never reflects as perfectly as on a geometric drawing and for other reasons. For example, the backing is always rough. The surface of the mirror is not a geometric plane, but the weave of molecules causes a lot of dissipation in the process. However, some experimenters believe they have proved sufficiently significant asymmetry, the difference in the expected reflectance angle from the incidental.

If we accept that the photons of polarized laser light reflected negligibly deviate from the expected reflection, as they claim, then the photon has a mass. Moreover, this mass is eccentric; the center of the mass of photons is not its geometric center.

Eccentric photon

In the next picture on the left we see an eccentric photon. Turning as it moves along abscissa, such a



photon oscillates, giving a new explanation to wave and particle dualism. The resulting impulse forces this photon particle to move along a wave curve. Because of the mass and gravitational force that attracts, we can say that photons from distant stars turn into the gravitational field of the Sun.

Interestingly, this hypothesis can also explain interference. The first case is a constructive interference when the amplitudes are added. Two

monochromatic electromagnetic waves are in the same phase, products of an integer and full angle 2π , so their waves are followed and amplified. Angular momentums are added. The second case is destructive interference, when the electromagnetic waves are in phase difference, products of odd number and angle $\pi = 180^\circ$. Photons of two waves behave like one, but due to the difference in phase, they do not go up and down like a wave, but move on the right line.

By combining these two extreme interferences, we can understand cases with minor phase differences. It's even easier with this theory to understand the polarization of light. It is now simply an oscillation between the bars. It is not clear how this somewhat mechanistic theory is correct, but I state it because in the author's presentation there is no convincing disagreement with what I am representing here. Especially I did not want to ignore it because I believe in the possibility of diversified explanations of the same real phenomena.

Action

The effect or action S is in theoretical physics an abstract size that describes the total movement of the physical system. It is attributed to the dynamics of the physical system for performing the equations of motion. The actions are mathematical functionals (functions that map the vector space into a scalar field), which maps the trajectory, also called the path or history, into real numbers. In general, the different paths it maps into different values. Its dimension is [energy] · [time] or [momentum] · [length], and the SI unit is a joule-second.

Unlike energy that can be imagined as potatoes or apples due to maintenance laws, which can do anyone, the action is an abstract concept, less intuitive and thought from case by case, especially depending on the trajectory. It is used only once, let's say, to derive differential equations that lay people do not understand. We will not pretend that physical activity is a clear matter, but it needs to be known to be more useful and more fundamental than energy.

An important reason for the great use of physical action is the "principle of least action". According to this principle, physical bodies arrive where they need in the shortest time, the shortest way, with the least energy consumption, and the like. We saw this on a case of reflection of light. In the case of energy, we vary the Lagrange function $L = E_k - E_p$, the difference of the kinetic and potential energy that the body could have on different paths, and we choose the smallest value. The action is the total Lagrangian over time, the integral $S = \int L dt$.

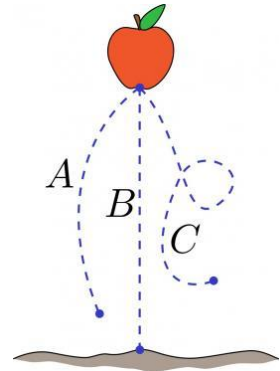
The famous Euler-Lagrange equations of the theoretical physics are the Lagrange function's minimum:

$$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{r}} \right) = \frac{\partial L}{\partial r}.$$

Depending on the given conditions, from these equations, or slightly modified, trajectories of celestial bodies are carried out under the influence of gravity, both in Newton's and Einstein's theory. Their solutions are the path of the springs, the swinging of the pendulum, but also any known movement in physics, including quantum mechanics.

For example, on the picture on the right⁷³, for the three paths of the apple fall, we can get the total effects $S_A = 4.3$ then $S_B = 0$ and $S_C = 10.8 \text{ m}^2 \text{ kg} / \text{s}$, so we conclude that B will be real. Similarly, the trajectories of the celestial bodies and choosing the minimal L or S we can obtain the geodesic lines of the body in the curved spaces of Einstein's geometry, and hence the ellipses, parabolas and hyperboles as their approximation, known to Kepler and Newton.

When a trajectory does not satisfy the principle of the least action, then we know that we do not have a phenomenon in physics, to be more precise, we know that we have no motion of dead substances. Then we are looking at the living being! This is the beginning of my story about perception information, which is a topic a little later.



⁷³ Gravity, <http://sciencenordic.com/gravity-it-all-your-head>

Here we first look briefly about the way Lagrangian works and the principle of the least action, without the intention of getting too far into it. For the physical phenomenon, the positions of the given body should be defined, for example, the vectors $\mathbf{r}(x, y, z)$ in moments t . We observe the movements of this body between two points, between the vector \mathbf{r}_A and \mathbf{r}_B in the time interval from t_A to t_B . The body from point A goes to point B, so we calculate the values of energy differences (Lagrangian), which we then integrate to get the action. Of all possible ways we choose the one with the lowest value of S .

It is clear that a lot of things need to be known about the moving body and the space in order to choose the minimum. That is why it is so surprising and ingenious the discovery of Lagrange and Euler that have found the general equations of motion for all these fantastically different situations.

What is Lagrangian Mechanics?

Lagrangian = $L = KE - PE = T - V$

Equation of motion can be determined by:

$$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{x}} \right) - \left(\frac{\partial L}{\partial x} \right) = 0$$

Let: $v = \dot{x}$, $y = x$

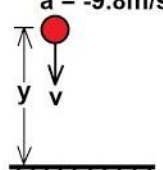
$KE = \frac{1}{2} m \dot{x}^2$ $PE = mgx$

$a = -9.8 \text{ m/s}^2$

$KE = \frac{1}{2} m v^2$

$PE = mgy$

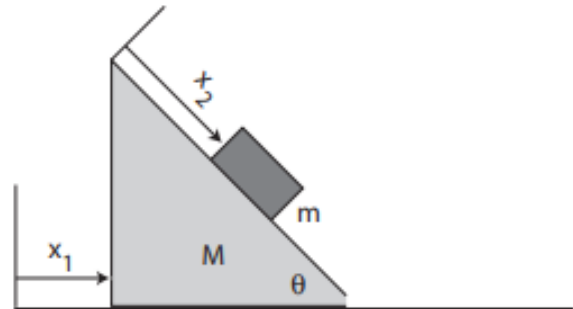
$g = +9.8 \text{ m/s}^2$



On the left is a detail from the calculation of the free fall in the gravitational field on the surface of the Earth. Next to the right is the complex movement of the masses M and m on the inclined plane. Both can be obtained by varying the Lagrangian and by taking the least action.

Of course, both of these two movements can be obtained by using the old Newtonian mechanics itself. However, the "least action" method is equally universal in Maxwell's electrodynamics, in thermodynamics, in the theory of relativity, in quantum physics.

We will not make a mistake if we divide all the inanimate and living worlds of the substance that surrounds us into one for whose Lagrangian is valid the principle of least action and the one that is not valid. This second mentioned is a living being. For now it seems to be all matter is the universe.



The Lagrangian equivalent in QM (Quantum Mechanics) is Hamiltonian. In analogy to classical mechanics, Hamiltonian is usually expressed as a sum of operators that correspond to the kinetic and potential energy of the system ($\hat{H} = \hat{E}_k + \hat{E}_p$). All such (linear) QM operators behave equally with the physical terms they represent, so Hamiltonian is the total energy of the quantum system. It is the central figure of classical QM, but not so much in relativistic.

The reason why the Lagrangian may be more popular in relativistic QM is that it sets the time and space coordinates on the same basis, which allows us to write relativistic theories on the covariant way (that the laws of physics remain unchanged). Using Hamiltonians, relativistic invariance is not explicit and can complicate many things.

An important place in both QM also has probability, and therefore information might be soon. Hence we need the interest for Lagrangian in QM because the principle of information irresistibly resembles to the principle of the least action. Nature likes to skimp, but has set some limits on itself. Because of the

principle of probability there are uncertainties and realization of information, but so that the information emission is minimal. From this side, nature would prevent us from transmitting energy or impulses if it is not limited by Heisenberg's uncertainty relations. Thus we arrive at the mentioned freedom $S = S_1 + S_2 + \dots + S_n$, where the summands $S_k = a_k b_k$ are orderly for $k = 1, 2, \dots, n$.

In order for such S to be a good representation on one side as the action, and the freedom on the other, we see on the following way. If we consider freedom as a measure, the quantity of options, then it is also a natural phenomenon for which the principle of the least effect applies. Regardless of whether Moses really existed or not (about 1300 BC), whether he was a religious leader, the legislator and the prophet who brought the Jews out of Egypt, he has charisma. This charisma is so much greater as the greater strength of his will is (a_k) to lead out the Jews and, at the same time, the greater power of prohibition (b_k) by Egypt that this practice is not performed. Accordingly, Moses is the bigger historical or mythical figure, as the larger is summand S_k in the measure of his freedom, that is, "vitality".

The same formulation of freedom becomes a measure of "deadness" if applied to non-living matter. By mean of Heisenberg's relations we write $S = \Delta x \cdot \Delta p_x + \Delta y \cdot \Delta p_y + \Delta z \cdot \Delta p_z - \Delta t \cdot \Delta E$, multiplied the uncertainties of position and time with the momentum and energy, which sum is minimal, the order of the size about the Planck constants. Note that in the case of an inanimate being, that is, "deadness", the increase in the first factor in the product means the reduction of the other and vice versa, unlike "liveness", where the larger factor goes with the larger (and smaller with the smaller one).

For constant series of coefficients a_k and b_k , when we multiply larger with bigger (and less with smaller) and add the products of these pairs in S , we get a maximum sum⁷⁴, and when we merge less with larger (and larger with smaller ones) we minimize the sum⁷⁵. It follows that "life" has a greater physical action than the "dead" substance. As that sum energies, Lagrangians, these living cells have not only greater freedom (quantity of options), but also greater energy. This surplus energy of living beings maintains their metabolism, and which again gives them greater freedom of movement.

That the constant freedom expressed by uncertainty means the absence of force is proven by the performance of Lorenz transformations⁷⁶. A higher value of freedom corresponds to a higher value of energy (the same substance) and a greater amount of choice, and therefore to more information.

However, greater freedom allows for greater lying, which principle of information allows and even requests. Nature is woven by the truth, but she loves to wrap them up. That is why Maat, an ancient Egyptian goddess of truth and righteousness, will, at the entrance to the world of dead by feather of "truth" inspect the dignity of man, believing that those who have used too many lies for life do not need to go on. They should be thrown away to the beasts, because they wanted to change the light truth to the darkness.

⁷⁴ see [3], Theorem 1.5.4.

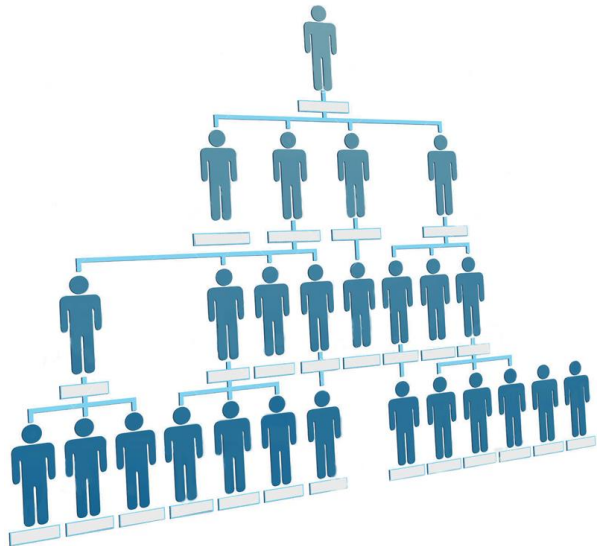
⁷⁵ see [2], Theorem 1.2.7.

⁷⁶ see [2], Example 1.1.2.

Organization

Religion is the expression of people's need for authority. It is also an indicator of our ability to hope, to believe in something inexpressible, and to think abstractly. It will be confirmed that it also undergoes important common features, as well as the organization of living beings in general, these with living beings themselves, and those with physics. These are the principles of finality, probability and information, among others, because living beings, as well as their organizations, are also material.

The history of religion is calculated from the invention of the writing about 3200 years BC, and at about the same time the human organization is monitoring. But this is another type of coincidence, less important here. In its way some of the common forms of these structures are also irrelevant to us. Let's say known descriptions of gender, tribal, state organizations, empires, or, on the other hand, political, professional, military and corporate organizations.



More important is the characteristic of religion in the narrow sense that it is the belief and worship of the superhuman power of control, especially in the personality of God or gods. Similar traces are found within each serious organization of people, but they are also just a step towards what interests us. Like bulbs composed of formal truths themselves, the human body is the organization of many trillions live cells. In a similar way to which the tissue cells allow it to live and reproduce, the cells of the organism are merged into a larger and more complex living entity.

Both trigger the same spontaneous escape from the surplus information that the molecule of gas entails into a uniform and impersonal distribution, but a different form of dead matter that is unable to maintain sufficient surplus information. Unlike non-living, living beings have this surplus with which they can manipulate. It is therefore spontaneously, driven by the principle of information, move from equality to the state of order and hierarchy. Running from uncertainty, which is Pandora's⁷⁷ box of development, living beings are giving up freedom for greater security and efficiency. They hide the information by packing it into the organization.

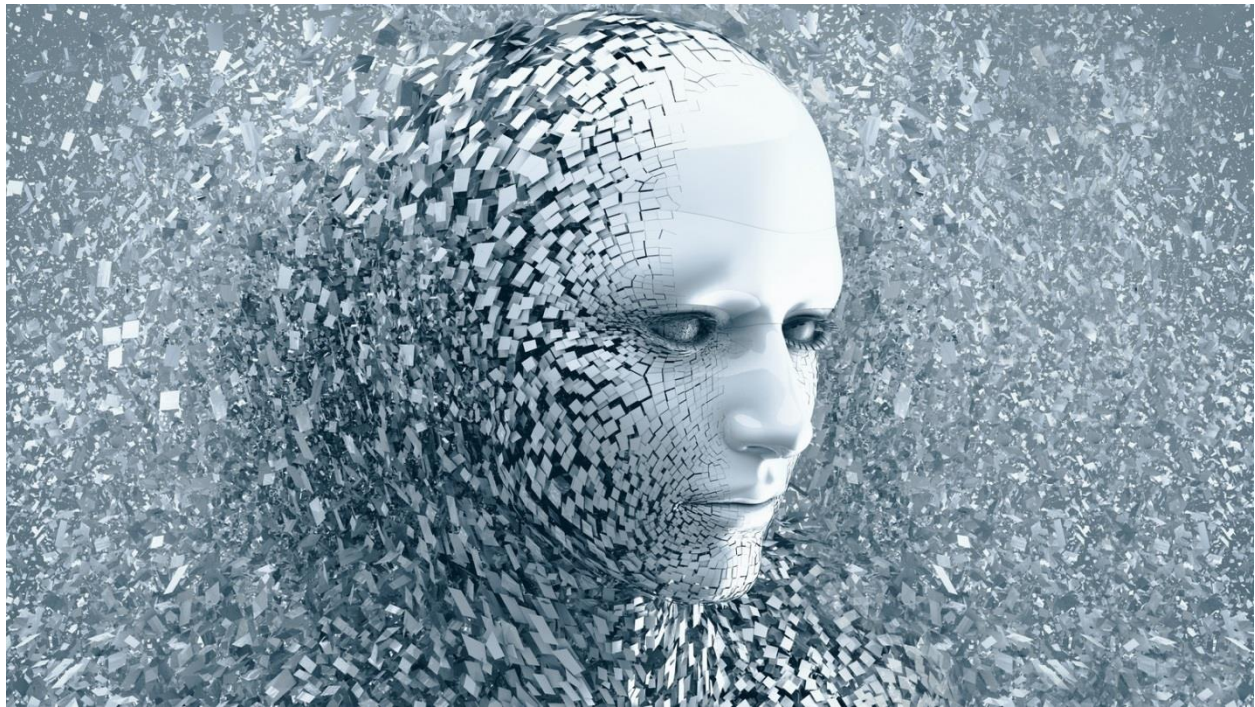
The evolution of life on Earth is not only contained in the simple interpretation of Darwin's processes, survival and reproduction in the random sequence of equal choices, but also in some still undisclosed laws that condense simpler forms of life into more complex ones. Randomly expanding to unknown options with ejection of the worse is more efficient, but also more mysterious than thoughtful development, especially because of the limitation of the mind against natural possibilities. Again from these here mentioned manifolds, always larger than each whole.

⁷⁷ Pandora (Greek Πανδώρα), in Greek mythology, is the wife of Titan Epimetheus. Pandora is a woman who brought evil and suffering to the world. Pandora's name in translation from Greek means everything endowed, because it is a compound of two words - *pan* = all and *doron* = gift.

Intelligence

As we do not consider as an authority the official who consistently follows the strictly prescribed rules, so intelligence we do not consider the ability to calculate a machine that literally executes the code instructions of a previously written program. Both do not have an objective coincidence in their work. In order to be considered something of the real authority; it must have at least a small property of a living being that can make decisions. We similarly distinguish automatic behavior from an intelligent one. This is in line with the previous one in this presentation.

Intelligence is the ability of a living being to use the available options. It follows that greater intelligence has an individual with a greater "amount of perception" of reality. Then we perceive not only all that is available to the senses, but also thoughts. Unlike learning modern psychology, here the intelligence implies skills, and we extend the term to possible machines, aliens and in general living beings. Because intelligent abilities involve the plastic and independent characteristics an individual can have in relation to his environment, intelligence is a vector size. It consists of a series of components that are measures of individual objects of the environment. In the same way, we associate these objects with other values, the components of the hierarchy. The hierarchy is the ability of the environment to deprive the living being of the available options.



As the ability to perceive, avoid, or control constraints is also a perception of an individual, for greater "quantity of perceptions" we need to recognize the one who sees more external disturbances. In short, the "amount of perception" is called information of perception, and we regard it as value proportional to the abilities we call intelligence, the vector \mathbf{a} , and the constraints we call the hierarchy, the vector \mathbf{b} . Perception information is their scalar product, number $S = \mathbf{a} \cdot \mathbf{b}$.

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The fact that the name "information" for the measure of perception is well selected indicates the possibility of reducing this expression ($S = a_1 b_1 + \dots + a_n b_n$) to Shannon's⁷⁸ information, where the first factors in summands are probabilities (realization objects of the environment), and other factors are the logarithms of these probabilities. Shannon's information is the expected (mean) value of Hartley's information of a set of random outcomes of varying probabilities. On the other hand, the scalar product of the vector is verified by the notion of algebra in the sense that it is not contradictory. Therefore, we can consider S as a satisfactory release of information.

The total intelligence of the individual and the overall hierarchy of the environment is the intensity, the vector $a = |\mathbf{a}|$ and the vector $b = |\mathbf{b}|$, respectively. Plasticity of intelligence means the ability to easily change the value of the components rather than the norm. If we have interpreted this feature well, then a more successful manager will be more tidy, predictable, and crawling in side features like the exact departure and arrival, daily routine, dress modes, because his useful intelligence will be able to focus on more important acting. This is the plasticity of a fresh sausage that is squeezed from one side and can explode on the other.



Because the hierarchy is in social relations, and especially it is information of perception, less variable value than intelligence, putting less intelligent personnel on party, official or police duties, we will have a greater influence of the hierarchy on them, we will get better listeners. In another extreme case, setting intelligent (in the sense defined here) we risk threats to others because of their supremacy, as was the case with Al Capone, Napoleon, Caesar, Moses.

⁷⁸ Claude Shannon (1916-2001), American mathematician.

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In the book "Information of Perception" (see [3]), you will find many similar examples given for testing the quality of new definitions more than just to carry out new repercussions. Intelligence is considered to be the ability to acquire and apply knowledge and skills (here and in the art itself). Thus, Albert Einstein once said in a popular way: "Measure of intelligence is the ability to change," and Stephen Hawking further paraphrased it: "Intelligence is the ability to accept change." With the understanding that real changes are not without originality, and those without uncertainty, we see that the intuitive notion of intelligence we have not been desecrated.

Defined by perception information, the intelligence is no longer reserved to people. Perceptions also have animals and plants, and they also have an organization. Accordingly, the new definitions ($S = \mathbf{a} \cdot \mathbf{b}$) imply the same applicability to the grass, ants, and primates.

Plants and animals from the same environment do not have the same perceptions. For this reason, for example, many caterpillars are not pests to conifers. They do not compete with the same limited resources and can therefore be in symbiosis, unlike the deciduous trees against which the conifers are fight by releasing poisons into their surroundings. The plants that have less perceptions have less developed intelligent behaviors and also less needs. With lesser perceptions of the grass and their poorer organization than ants the lawn we considered less intelligent than the ant colony. Both as vectors of a very small (positive) intensity compared to a human organization.



Due to symmetry in the formula of perception information, intelligence and hierarchy are dual terms. Roughly speaking, what is social order for us, we are for our cells, and an ant colony for ants. Consistent, the hierarchy is a type of intelligence.

We have seen that perception information is proportionate to physical activity, so it is also proportional to work in unit time. It is clear that a larger tree may have a higher perception than the smaller, but this does not mean direct and greater intelligence, so it is necessary to work with some kind of specific perception, for example, the value S in the unit of volume, area, or the unit of the individual body mass for even more precise expression. We're not going so far out here.

We will only notice that a larger computer has a greater chance of being more intelligent and organized, but that it does not have to be relevant for its overall effect. Thus, for example, the effect of much less Napoleon's army against the Allies in the Battle of Austerlitz was more successful. As we know, this "Battle of the Three Emperors" from 1805, is one of Napoleon's greatest victories over which he defeated the third military, then the Russian-Austrian coalition, designed to destroy the French Empire and prevent its spread. Also, many components of the intelligence or hierarchy do not have to be important, because even when they are very many, they can be insignificant and negligible. Thirdly, for product vectors of the intensity of the closer values of the effect, we will say that they are better coordinated.

Equality

The state of equal abilities and equal opportunities we call equality does not exist. In the fiction of equal abilities and unequal chances, we would have injustice, and in the opposite case, the unequal abilities and equal prospects begin the struggles for domination.

Just eight years ago, similar attitudes would be very controversial. From the claim that the same person and equal conditions do not exist, through the statement that insisting on equality generates conflicts, that equality is the ideal soil for hierarchies, and finding the causes of an increasing gap between the richest and the others in liberalism itself. In the best atmosphere in the intellectual conversations among the intellectuals on these theses was seen as good jokes.

In a favorable approach to my explanations of the “incorrect settings” of the legal systems and the finding of “contradiction” of liberalism in its very definition, a colleague recommended me a list of educational books, not doubting my ignorance of things — If you are a mathematician, the freedom is a number, and if you are not what it is? — He asked me roguishly smiling — But I say — I was speeding up — the freedom is an amount of uncertainty, the kind of information for you and for us, and there are more when the options are equal. Freedom is in options, in uncertainty, and the amount of such increases with equality — I was persistent — And besides, it is a fact that nature does not love the truth! — I would end up in the run until others might have not listened to me more.

In trying to quickly draw attention, I did not have enough time or wisdom to devise a better deduction.



These conversations often resembled refilling of sand in the desert. But things changed little over time, after my first texts, and then the books "Information of Perception". These desperate discussions were the motivation to first write about society, not about the physics of coincidence.

You need to admit that sports competitors are positioned in as much as possible equal starting positions, above all because of more intense fighting and better results, and only then for the justification of democracy. The same reason for equal starting positions we have in economic competition, in front of students, among job candi-

dates — filtering the best ones. That's how I talked those many years, long but on time less in vain.

Now I do not have much to add. Nature is really upholding the truth, although the material world is a set of final shells built with abstract truths. They partially receive uncertainty forms from which we could get information. The most probable events are the most realized, which is the principle of probability, so the nature gives the information to a spoon, which is the principle of information.

That's why the struggle for equality is the job of Sisyphus. In order to avoid conflicts where we do not want them, spreading the idea of equality, we are developing the state of law. This has become a mania

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of the liberalism ideology, that the freedom of the individual should be defended by the state. The definition of liberalism in itself contains the idea of racketing, feeding the power of the state on the account of the privacy that is transferred from the individuals. In the name of freedom, in order to protect freedom, we renounce of freedom. And like many other misfortunes that begin as beautiful, the stealing of foreign rights by the state in early liberalism was invisible due to the seemingly immense ocean of freedom that was yet to be conquered.

Increasing differences, on the one hand, a reducing percentage of people who have an increasing



percentage of the world, and on the second all the others, are the result of liberal capitalism. This separation is created because of the more efficient state infrastructure, the protection of the wealth of the rich they offer, and then because of the very nature of the monopoly, to get the more you have the more to have.

Typical is the structure of the power in general.

Equality in chances maximizes the amount of uncertainty, and therefore the information, so a situation arises that nature makes everything to thwart that status. Striving for the disruption of inequalities, spontaneously starting the fighting for the domination of individuals, arise the organizations, than the conflicts among the resulting hierarchies. Due to their greater efficiency over equal, hierarchies become sharks in the sea of small fish in democracies. Successfully overcome.

Thus, the US democracy was subordinated to corporations. They continued to exploit the state apparatus for their robbery military hikes to other countries that were equally hypocritical concealed by democratization, then by the most drinkable dogma. Though confused by the mess afterwards, they turned it into alleged success by spreading lies about secondary goals. Similarly, communism (the equality of the working class) brought lifelong presidents, France took over Napoleon after the liberal revolution (1789-1799), and the equality of people before the Catholic God created an inquisition. This is the other side of the insistence on equality and the rise of a powerful state law according to which every slave-holding system from the past would look like a childish game.

The approval mechanism is also explicit. All living beings feel comfortable in a narrow strip of values of liberty. On one side of these values are unpleasant and terrifying uncertainties. They move us to be careful. On the other side, there are difficulties and resistance to the grasp of restriction, that is, the lack of freedom. The range of comfortable freedoms is not equal for everyone, but most are asking. More people will do more work, but the mass is less intelligent than the average individual! It therefore more often fears of freedom, demands more order, security, and efficiency. A smarter minority suffers, avoiding to disprove democracy, something embroidered here and there, but also be quiet and blur, because the situation opens up the possibilities for manipulation too, now on their side.

Freedom is a physical action. It does not mirror so much in the jounce, in the games on a certain, as it is in a brave march to the unknown. There is more freedom in aggression than in outflank, more in the

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uncertain neighborhoods of New York than in the safe squares of the communist cities. However, all legal systems, two steps forward one backward, prohibit more and more of "aggressive" behaviors.

Legal systems now invents aggressiveness to forbid it. The smallest occasion, which would once remained as a statistical error, is questioning now revealing its threatening options, and negligible mistakes or the slowness of justice go under the carpet. Legislation is a machinery that must work, based on its loyal people. From the perspective of some future researchers, our society will look as if it was obsessed with regulations. It will later admit the unnatural nature of today's flows, in contrast to the scantiness of the universe, and modern legal masochism will break into the minimalism of the law, to cover as little as possible with no more scruples. I hope.

In the race of legitimization, the most precious pray today are risky initiatives and the forms of behavior that we usually say are male. This is the time of feminisation of legal societies and the question is why? According to the assumed coincidences, nature surprised us, in turn with so big obstacles that polish spieces or adaptated on predictability fail in evolution. With this attitude, we find biological genders useful.



I'm talking about nuances in the behavior of esxes that, as in the chaos theory, lead to great final differences. It is understood that the root of all is reproduction. Furthermore, it can be noted that that the female sex is more oriented to the internal organization, the male external. Women's to refinement and security, male to risky initiatives. Him rushing and suffering, now we can say providing better chances for survival of the species in cases of risky environments. She add stability to it.

That's why chimpanzees are hunters (by alpha males) widespread across the equator, and to them (and us) the most related specie is bonobo monkeys that lives in a protected niche surrounded by a delta of the Congo. Female's communities are collectors, a large family of sister bees, vultures (hyenas), or they are simply so big individuals that are not threatened by external danger (elephants). According to this theory, the rule over nature our civilization spontaneously leads to equality, and further through the development of the legal system in feminization. And that's the kind of road in imbalance.

In the case of a general peace in the world, the American form of corporations and imperialism would lose against international law. This male form of organization and the male mode of the game (who risks gaining profits) is dual with the legal systems that we (approximately) called female. Introducing the inner order, adhering to the principles of justice and morals, but above all because of the unstoppable need for ever greater security, in the fight against capital, lobbying, roaming, the conflict is jin-jang. This competition of two values represents us as a struggle of good and evil. The violators of the rules of the game of safety are the bad guys, with the intention of spreading goodness to the lobbyists, and then to the bolds who lead others to the risk with courageous initiatives, then others who are disturbed by their perhaps unpleasant intentions, with a predominant view, then even with the least uncertainty. However, the final victory of certainty may fall out as Pyrrhic victory.

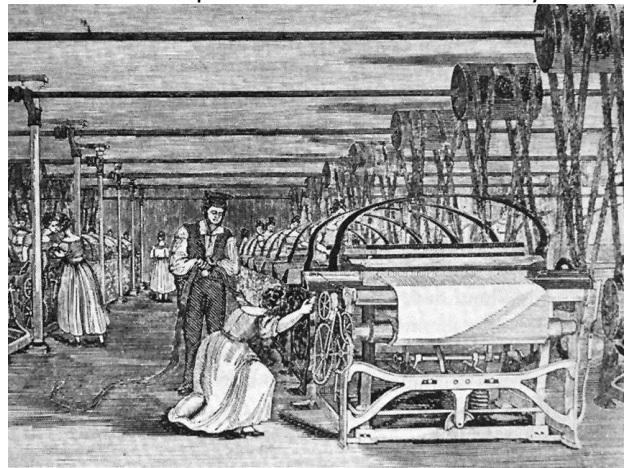
Development

Consistent with the theory that assumes that there are objective coincidences, we redefine the notion of development. The changes with which comes the news, originality, we consider bigger developments. We will say that there is not so much development in the movement of the Earth around the Sun or in the life of a dragonfly, as it have our civilization in the last 100 years. Therefore, the notion of uncertainty, information and development are on the side opposite to safety and efficiency.

Already in the case of first application, economic and legal development, this definition seems paradoxical. How do economically extensive countries generally have the most workaround legal systems? The positive economic development, according to this theory, is on the same side with mastering uncertainty, innovation, courage, while legislation, administration and in general the increase in the scope of state restrictions, on the contrary. It is absurd that for more originality the more non-originality is needed, if we do not recall the "least action".

Consider this on the experience of the industrial revolution in textile production. In the British city of Lancashire, the traditional count of England, it was the center of textile production of steam engines, which later expanded throughout the West. It was the culmination of one efficiency after inventiveness, the point of rest after movement.

In 1775, Watt⁷⁹ patented a piston steam engine that transforms the heat energy of the water vapor into mechanical work, mainly in rotational motion. Soon began the application of his machine in the industry of Western countries, which is called the Industrial Revolution of the 18th and the beginning of the 19th century. It is significant because of the great economic development that followed. However, if there were no new innovations, their economic development would have stopped to date.



Power Weaving 1836

The paradox of efficiency is in its prevention of development. That is why we know the capitalist crisis for which we have not yet seen a satisfactory theoretical explanation. When it peaks in the structure of profit generation, the maximum of efficiency, the company achieves its minimum development. This is followed by lagging behind for others that we would say that there is a decline in efficiency even if nothing in the way of doing business would change. The possible recovery of the so-called economy is possible with a leap into a new efficiency. Here, "new" means such a different efficiency that it is necessarily accompanied by a breakthrough in the field of uncertainty, that is, originality and development. These jumps are called crisis capital.

There is no development without coincidence, and it is no coincidence that large industrial development has been achieved at the time of the liberation of the forces of freedom. The Industrial Revolution took

⁷⁹ James Watt (1736-1819), Scottish mechanical engineer.

place at a time of tolerance of spinning and progress in the field of engineering. Moreover, this is the time when the society celebrated invention and when that kind of interest began to get the support of state institutions. Let us not forget that the societies with the highest development in one area can be very rigid in the other, such as the US in the fight against communism.

This repressive side of the community was more often related to social phenomena, and knowledge in these areas was therefore lagging behind. Today's belief is that social sciences can not be based precisely. To my mind, it was on the hustley legs as it was similar to the belief in coincidence in time before the mathematical theory of probability. If not, would manipulation, misinformation through public media and other prohibitions be as successful as we know they are in politics? They give power to state laws, despite inaccurate legal assumptions.

Legislation limits freedom and channel the development of society. Together with other state institutions, it creates the preconditions for community development. Hence, when the legal system achieves superior efficiency, when it becomes overburdened, overloaded with administration, or brings too many wrong laws, society's development stops. This conclusion (perhaps) is so incredible that I spent hours and days in vain with some lawyers trying to explain it to them. I'll try to remember the more interesting parts of those conversations.

The saying "better any than no law," should replace the moto "better no one than any law" as soon as possible, if we want development. This is because unpredictability, including those unpleasant things that we want to limit by the law, is a prerequisite for real change. As there are no genuine original discoveries on the paths that have been laid down, so there is no true science without pain, I want to say without facing the horrors of uncertainty.

We see it everywhere around us, unfortunately for those who prefer order, safety and efficiency. For example, the peoples of the Philippines, the island nation of Southeast Asia with some 100 million inhabitants, suffered from an inexhaustible number of deadly typhoons, earthquakes, eruptions of volcanoes and other natural disasters. This is due to their location along the "hot belt" of the large Pacific region. However, artificial accidents (administration) were tolerant to economic development, and last year (2017), Gross National Income (GDP) grew by 6.7 percent, which is elusive percentage for any European country.

During the largest growth of the American empire it had a small density of administration. By the way, neither nature was their friend at that time, at least not as much as Europeans. It was similar to Japan at the time of their great economic rise during the second half of the 20th century. What we want to ban more often is unpleasant than it is harmful! This is the truth that legislation easily overcomes and causes damage greater than a natural disaster. We do not want the truth to hear as the justification of the lies we believe in. The problem with jurist is even greater because they are too trained to recognize those popular desires before the truth.

Why is it so difficult for today's people to explain what is seen in ancient Greece as being normal, to get uncertainty through effort and suffering, not by hedonism, and by shifting the head into sand? It could be because the modern human rights ideology. Putting man at the center of all is the root of our

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ideology, an epoch that celebrates selfishness. The culmination of the protection of individual ego by the state becomes a convenient excuse for strengthening the state laws, and then the target and the basis for abuse of this new power by various interest groups (lobbyists).

There is currently a struggle between the rule of law (female principle) and corporation (male principle) for domination. Because of jin-yang, it turns out that in this conflict, neither is the good victory of the first, regardless if that means peace in the world, nor is good victory of the second with the subjugation of all to the judiciary. The each is unpleasant completion.

I will explain this in a very different way. It has long been noted that society resembles a living organism. Both have common phases: youth, maturity and age. Add to this that the phase of youth has an excess of freedom and risk, and lack of experience and consistency. The development of this value is slowly being replaced. This reminds us of strengthening the rule of law, its security and efficiency, aging.

Then we note that the evolution sometimes less developed species (conditionally speaking) advances by association of individuals into colonies and larger organisms. Roughly speaking, each of the trillion of the living cells of our body is able to perform functions of each other only if the appropriate (chemical) switches are involved. It is similar to the tissue of the tree, or some third complex living organism. Common to all such tissues, in analogy with the legal system, is the great absence of freedom of individual cells at the expense of the whole. They are doing very specialized jobs, like almost perfect slaves, as robots (without intelligence), that is, as a distant ideal of modern lawmakers.

According to this analogy, the success of society enrichment by administration is measurable, for example, by a fall in birth rate! I purposely quote this unexpected example for encouraging (perhaps some) readers to test these theories in various ways, especially where others are still not reaching. So, I suggest that the negative correlation between the density of the law and the number of born children per person is compared to the so-called the paradox income-fertility, and the birth-rate with a tumor.

In addition, it can be expected that by development of a law the society is becoming old and feminized. I hope, not too fast to "general peace" on Earth. This is the path of an increasingly intrinsic organization, to the degree of tissue of an organism, when, for example, the "male principle" weakens, and states become a "sisters company". Those with more interactions would then peacefully associate themselves with even more complex communities. Otherwise, as long as human communities do not look like trees in the forest, and individuals on living tissue cells, we will know that the legal system is still struggling with bad guys.

Epilogue

As the author, I was invited to hold a lecture on topics from the books "The Mathematical Theory of Information and Communication" [5] and "Nature of Data" [4] in the reading room of the National and University Library of the Republika Srpska in Banja Luka (February 26, 2010). More interesting questions then remained open, and some were the reason for working on the remaining three books printed in the following years and here retailed.



Is the information sufficiently physical that we have a free will? If so, can the firmest nut of determinism, the classic mechanics, explain the points of mechanism by probability? Is there any more probability in quantum physics except Born? Is there a complete certainty? How does this reflect on the structure of the universe?

I hope that the reader noticed the depth and the inexhaustibility of these subjects, but also that they are not untouchable. It could motivate some future researchers, I believe, as well as to bring the described problem closer to less inform. To leave not the quantum mechanics in pure mathematical formalism, and nothing further, with a frail professor of quantum physics who must say to his curious student, "Do not think, but keep quiet and count!"

Appendix

I owe special gratitude to colleagues who, as lectors (or reviewers), carefully reviewed the text of the book and after that gave me very useful remarks. The following contributions reveal a part of the seriousness of their work.

Continuum, finality, and Plato

How real numbers are real?

British biologist Rupert Sheldrake once said that he had met many mathematicians in his life and that he did not encounter anyone who could not be said to be a Platonist. Those who are not referred to in ancient Greek philosophy are enough to look at Wikipedia and there will find basic information about Plato, a great philosopher of the ancient times. Here, I can learn about the most important aspects of his philosophy and find out that the starting point of his philosophy is learning about **ideas**, which are the only real reality, and the material world, the world perceived by senses is only a picture of the world of ideas. Ideas are eternal and unchangeable, and sensible beings are changeable and imperfect, and they exist only for participation in ideas. Among the ideas there is a hierarchical order. The highest is the idea of a **good** that is identical with the deity. Every idea exists and has a place on the hierarchical scale for greater or lesser participation in the idea of good. Contrary to the world of ideas, there is **matter**, which also, as a chaotic, unsettled mass, exists from eternity. The world is created so that a **demiurge** (i.e. a creator who does not need to be identified with the deity) shapes matter in the way of ideas. At the same time, Plato does not interpret the relationship of the demiurge on to the idea of good, that is, to the deity, or to the relationship of the idea to the deity. According to Plato, knowledge is only a memory of the world of ideas, which is more successful than the soul with clean life is freer of the influence of the body.

It should be noted that the very word of the idea (of Greek origin) today has a different meaning than in Antic. In fact, this word has many different meanings today, and its original meaning has almost disappeared. This original meaning could be described as: the visible and imperfect idea of a concept, or a transcendental entity.

There are really many mathematicians who, to say so, "live and work" in the world of mathematical truths, theorems and their proofs. Some of them even openly say that they are the followers of Plato and that they can identify his world of ideas with the world of mathematical truths. Here we could mention the Danish-American mathematician and quantum physicist Max Tegmark who wrote a rather read book titled "Our Mathematical World". My colleague Rastko Vuković, in my opinion, is somewhere in the middle. I've been following his work for many years and I think that it is undeniable that there is this "Platonism" in his thinking on mathematics, quantum physics, information theory, continuum and finality, reality and perception. He only partially acknowledges this and insists that the "world of truth" as he calls it is not the same as Plato's world of ideas. However, let the readers form their opinion on this.

Here, I would like to look at the key setting of several books of my colleague Vuković, perhaps best summarized in the foreword to the book "Multiplicities":

"This is the theory of a substantive world of physics which is a very negligible part of worldly laws, temporarily called reality within pseudo-reality, and then about living beings that are almost insignificant parts of the entire material environment. It is an attempt to connect mathematics, physics and life to the exact, or at least in a serious natural-philosophical way. "

For the material (material) world, says the author, the principle of finiteness (or at most countably Infinite) is valid, while the pseudo-real world is a true continuum. All those who know a little better mathematics will remember the key differences between finite and infinitely countable sets (for example, a sets of natural and rational numbers) on the one hand, and uncountable sets (for example, a set of real numbers or a set of all dots on a line) on the other. The continuum principle applies to these others.

Among mathematicians and physicists, there has long been a dispute over whether the world surrounding us in its deepest essence is continuous or discrete. The dispute is far from being decided on one side or the other. Although my colleague Vuković did not, as I said, directly involved in this discussion, I think that, nevertheless, his books contributed significantly to this issue. First of all, I mean what he calls "the principle of finality" and "principle of probability". I do not want to take a stand on this matter, but I'd rather give the word to the smarter ones. I will present here a controversy between two great contemporary mathematicians (and informatics) of American Gregory Chaitin and British Edward Ashford Lee about continuum and discretion, then reality and real numbers. I am doing this also in order to illustrate in what extent colleague Vuković is in the process of the most progress events in mathematics and theoretical physics.

Gregory Chaitin, who is best known for his contributions to the algorithmic theory of information, has in some of his papers brought into question the "reality" of real numbers. He emphasized mathematical, philosophical and computer problems with real numbers, and concluded that these difficulties undermine the generally accepted assumption that real numbers are behind physical reality, and he firmly suggested that physical reality must in fact be discrete, digital and computer (calculation).

Citing the first example of difficulty with real numbers, Chaitin quotes the great French mathematician Emile Borel, best known for his fundamental work on the theory of measure and the theory of probability. Namely, Borel claims that if we really accept the concept of a real number as an infinite sequence of digits (e.g. number $\pi = 3.1415926 \dots$), then we could put the whole human knowledge into one single real number.

Chaitin calls this number "Borel's surprisingly omniscient real number".

One way to construct a Borel number is to list, in a sequence, all the yes-no questions that have answers (if Borel's questions were, say, in French, then it would be possible to sort by length, i.e. the number of characters, then by alphabetical order). They can be listed so because the set of all texts in any fixed written language is countable. Then the Borel number can be represented in binary form as $0, b_1b_2b_3 \dots$ where $b_i = 0$ if the answer to the i -th question is NO, and 1 if it is YES. The number you get is a real number between 0 and 1.

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Chaitin concludes that Borel's number cannot exist in any reasonable way, primarily because it is not possible to "know everything". Edward Ashford Lee, however, thinks that there are some problems with this argumentation. First, what does it mean that a number "exists"? The German philosopher Immanuel Kant made the difference between the world as it is, things-by-themselves, (*das Ding an sich* in German), and the phenomenal world, or the world as it seems to us. Assuming that what Chaitin implies as "existence" is that it is a thing-in-itself, in that case, whether the omniscient number reveals to us, becoming a phenomenon, or not, it is irrelevant to its existence.

In fact, if the Borel's number exists as a thing-by-itself, outside of us, then it cannot be revealed to us. In his recently published book *Plato and the Nerd*, Ashford Lee discusses Claude Shannon's Theorem about the channel capacity of 1948, which claims that any observation with the noise of anything transmits only the final number of bit information. Borel's omniscient number cannot be encoded with the final bit number unless the list of all possible questions is not final, which is not the case. It's easy to construct an infinite sequence of valid, yes-no questions. For example, let the first question be "Is the one an integer?" Let the second question be "Is the answer to the first question YES?" Let the third question be "Is the answer to the second question YES?" et cetera. As a consequence, the Borel's number cannot be discovered to us unless we invent a silent way to observe things-by-itself. Assuming that such a noiseless channel exists, the channel capacity theorem implies that we cannot know the Borel's number. But this does not undermine its existence in any way.

Returning to the original question, are real numbers really real, Ashford Lee is wondering if the numbers are real? He argues that there is a risk here that a geographic map be confused with a real territory. To make the numbers real, we must assume Plato's heaven where universal truths exist independently of people. Numbers, whether whole, rational or real, would be the first "citizens" of these heavenly ones. Since the existence of such heaven is independent of the existence of people, then our knowledge of anything in them must be somehow obtained, either through observation or through introspection. If it is transmitted to us through observation, then it will be the subject of Shannon's theorem on channel capacity, in which case we can only know about things that can be encoded by the final bit number. If it is transferred to us through introspection, then their existence is a matter of faith, since their existence is independent of us, and there is no connection between this introspection and thing-by-self, by the definition of introspection.

Another example of the problems associated with the real numbers discussed by Chaitin is Richard's paradox, named after French mathematician Jules Richard, who first described it in a 1905 letter. Richard pointed out that all possible texts in the French language could be listed in a sequence in a manner similar to Borel's yes-not. One subset of these texts describes or names real numbers. But the number that is not described in that list can be easily described. Let's look at the sentence "smallest number that cannot be described in less than twelve words." These eleven words seem to define a number that cannot be on the list of described numbers. A more rigorous form of this argumentation would use Cantor's diagonalization technique. The text would describe this diagonalization technique, and therefore I would describe a number that is not on the list of all numbers that can be described or named.

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Ashford Lee says that any interpretation of the text as a number in a language (e.g. French or English) depends on the notion of semantics, and in its book *Plato and the Nerd* emphasizes that "the term semantics can use the countable world of software into an unlimited variety of ways." Semantics connects human knowledge with the formal and countable world of symbols, but we have no proof that the cognitive world is formal and countable. It is possible that Richard's paradox demonstrates that the written language must be ambiguous, perhaps because it bridges the countable world with that uncountable (cognitive).

Chaitin points out that when we eliminate semantics, we lose a lot:

"Formal languages avoid paradoxes by removing the ambiguity of natural languages. Paradoxes have been eliminated, but the price was paid for it. Paradoxical natural languages are open systems that evolve. The artificial languages are statically closed systems that are subject to the limiting meta-theorems. Paradoxes have been avoided, but we only have a dead body left! "

In formal languages, paradoxes are reduced to the Gödel's incompleteness and the reluctance of Turing, which are dry, to say "soulless" concepts when compared with nuances and ambiguities in natural languages.

Suppose the numbers are models (maps) that reflect some reality (territory). With this assumption, the question of Chaitin is whether the real numbers are the exact models of some physical reality. We can ask whether real numbers are useful models, but this issue seems trivial; we know they are. So, it is necessary to focus on the question of whether real numbers are true models of reality. Chaitin notes that some physicists consider that they are not:

"The last powerful hints in the direction of discretion come from quantum gravity [Smolin, 2000], and especially from the Bekenstein border and the so-called 'holographic principle'. According to these ideas, the amount of information in any physical system is limited, i.e. it is the final number of 0/1 bits."

Ashford Lee argues that in his book *Plato and the Nerd* showed that this hypothesis of "digital physics" is not falsifiable, and that it is therefore not scientific in terms of the 1959 Karl Popper philosophy. It can only be taken as faith. In addition, Lee argues, the arguments for digital physics are based on the incorrect interpretation of the Bekenstein boundary, which failed to recognize the difference between the entropy of a discrete random variable (which represents information in bits) and the entropy of a continuous random variable (which does not represent information in bits).

Chaitin also uses biology to uphold his digital faith:

"Other hints come from ... molecular biology where DNA is digital software of life ..."

Ashford Lee here quotes author George Dyson from his 2012 *Turing's Cathedral* book:

"The problem of self-reproduction is a fundamental problem of communication, through channels with noise, from one generation to the next."

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Since the reproduction is a channel with noise, it can transmit only information that can be encoded by the final bit number. DNA, therefore, can also be encoded digitally. There would be no purpose in some "richer" coding. Does DNA encode human beings? Ashford Lee in his book says this:

"Only the properties that can be encoded by the final bit number can be passed from generation to generation, in accordance with the channel capacity theorem. If the mind, or the characteristics of the mind, such as knowledge, wisdom, and our self-awareness, cannot be encoded by the final number of bits, then these traits cannot succeed in our offspring. It looks certain that DNA does not encode the mind because the mind of your descendants is not yours, and it is not even a combination of the minds of both biological parents. ...

If the mind requires mechanisms beyond digital for its functioning and character, then the mind cannot be transmitted through any mechanism through the noise channel. Your mind is entirely yours only. Not only that it cannot be transferred to your descendants but it cannot be transferred anywhere. It will never be able to reside in any other hardware unless we invent a channel without noise. Biological inheritance cannot provide a channel without noise, because if that were to happen, there would be no mutations, there would be no evolution, there would be no human beings and we would not have any mind at all. Genetic inheritance is necessarily digital, but the mind forms more than genetics."

Chaitin's remark basically refers to the concept of a continuum, which certainly leads to conceptual difficulties in the formal languages of logic and mathematics that people have invented. But these formal languages "live" in the countable world, so there should be no surprise that they have difficulty in comprehensively manipulating one unbroken world. Despite these difficulties, the cognitive concept of the continuum is not at all difficult to understand. Difficulties arise only when we try to communicate, for example by naming or describing all real numbers. But it is possible to understand it without communication. In fact, transferring understanding to others is a notoriously difficult job. Every educator is aware of this.

Ashford Lee concludes that the hypothesis that the mind can be digitally encoded is neither, nor digital physics is, verifiable until we can invent a way to measure the mind without the noise. Since we do not have such a silent measurement, this hypothesis is not scientific. If, in fact, the mind rests on a continuum for its cognitive functions, it could explain why cognitive functions cannot be inherited and why our minds can deal with real numbers, despite paradoxes.

Chaitin relies on the ancient Greeks when he gives his comprehensive conclusion:

"According to Pythagoras, everything is a number, and God is a mathematician. This point of view has worked quite well during the development of modern science. However, now there is a neo-Pythagorean doctrine, according to which all 0/1 bits, and the world is built entirely of digital information. In other words, now everything is software, God is a computer programmer, not a mathematician, and the world is a giant information processing system, a giant computer."

According to Edward Ashford Lee, this claim describes faith, not a scientific principle.

So much for that. The controversy continues...

How much dimensions are?

And now let us go to something completely different. Colleague Rastko Vuković has long been represent a thesis (which can be found in the book "Multiplicities") that the world has not only four dimensions (3 spatial i.e. length, width and height, and one time). This, of course, is nothing new; the string theory that applies to one of the most perspective (and the most fruitful, judging by the number of published scientific papers in the most prestigious scientific journals) work, if not mistaken, with up to 11 dimensions. These dimensions (if we accept the views of string theory) are, however, microscopic and do not manifest themselves in our macroscopic world, which is still 4-dimensional for us. However, colleague Vuković argues that the world has 3 spatial and 3 time dimensions. It has been very convincing elaborated in his earlier books (for those who can follow his logic and understand). As far as I know, no one besides him represents this (hypothetical) thesis. And again, I will try to invite people from who we can learn more than from me. In this case, they are Gerald Whitrow, an English cosmologist and John D. Barrow, an American physicist.

Whitrow was the first to connect the number of dimensions of space with the existence of live viewers in 1955. He asked the question, "Why do we see a universe with 3 (spatial) dimensions?" And tried to find the answer in the claim that thinking observers can exist only in 3-dimensional worlds. He suggested that it would be possible to carry out the dimensionality of the world from the fact that we (or some other form of intelligent life) exist:

"This fundamental topological feature of the world ... can be seen as a unique natural companion of certain other contingent characteristics associated with the evolution of higher forms of earthly life, in particular the Man, the problem formulator."

He elaborated his argument in a popular book on cosmology that he published four years later. He tried to eliminate the possibility of a 2-dimensional life-supporting world, claiming that the inevitable intersection of the connections between nerve cells in two dimensions would lead to a short-circuit in the creation of complex neural networks.

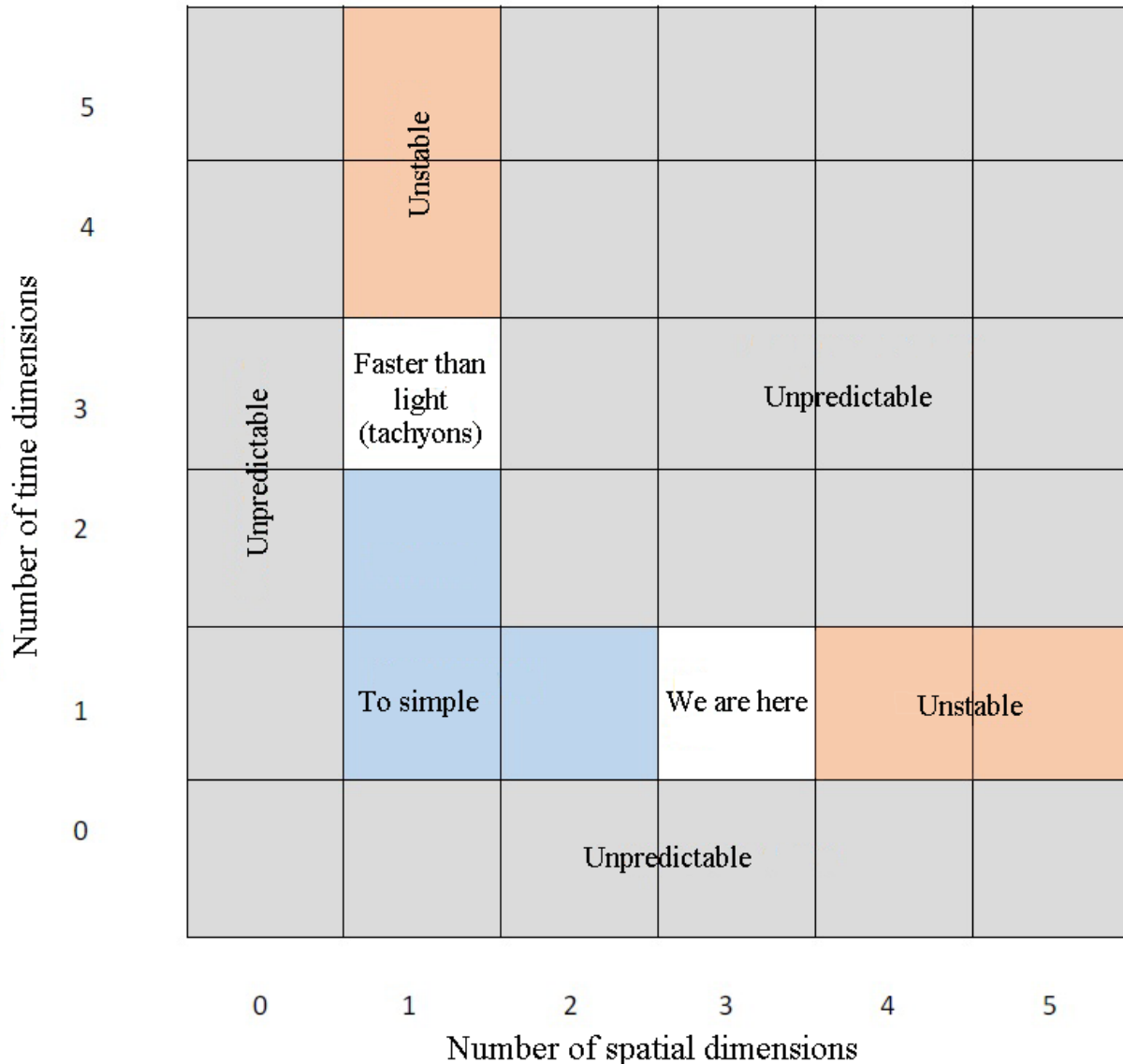
Whitrow's approach is the first application of what is now called the "anthropic principle". Using what we know today, we can extend this principle even further. If we are to think that the world could look if its laws were the same, and the number of spatial dimensions changes, the question arises why it stops? Why not ask yourself what would happen if the number of time dimensions were different?

The possibility of a universe with a different number of dimensions both space and time has been studied by numerous scientists. Just as when we consider universes with other dimensions of space and one dimension of time, we can assume that natural laws retain the same mathematical form, but allow the number of dimensions of space and time to freely vary across all possibilities. This situation is shown in the picture below.

John Barrow says that this "chessboard" of all possibilities can be dramatically reduced by taking into account only a small number of reasonable requirements that seem necessary to process information,

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memory and life at all. If we want the future to be determined by the present, then we eliminate all those regions on the "chessboard" that are labeled "unpredictable." If we want stable atoms that exist along with stable orbits of the body (planet) around the stars then we have to reject parts that are labeled "unstable." Writing off the worlds where exist only signals that are faster than light, our own world with $3 + 1$ dimension of space and time remains with very simple worlds that have $2 + 1$, $1 + 1$ and $1 + 2$ dimension of space plus time. Such worlds are usually considered too simple to have living beings in them. For example, in the $2 + 1$ world there are no gravitational forces between the masses and there is an inevitable simplicity of design that prevents any evolution of some complexity.



Despite these limitations, there were many speculations about how different devices could be constructed in 2-dimensional worlds. We already mentioned Whitrow's remarks about the corresponding neural complexity in the 2D world. Networks are extremely limited because the path cannot be missed without intersection.

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Worlds with more than one time dimension are hard to imagine and seem to offer many more options. Unfortunately, they seem to offer so many possibilities that elemental particles of matter are far less stable than in the worlds with a single time dimension. Proton could easily break into neutrons, positrons, and neutrinos, and electrons could break up into neutrons, antiprotons, and neutrinos. The total effect of the excess of time dimensions would be to make the complex structures extremely unstable unless they were frozen under extreme low temperature conditions.

When considering worlds with spatial and time dimensions different from $3 + 1$, we encounter a very pronounced problem. Worlds with more than one dimension of time do not allow the future to be foreseen from the present. In this sense, they are more like worlds without time dimension. Complex organized systems, such as those needed for life, would not be able to use the information collected from their surroundings for their future behavior. They would stay simple. Too simple to save information and evolve.

If the number of dimensions of space and time were chosen randomly and if all the numbers were possible then we would expect that number to be very large. It's pretty unlikely that a small number would be chosen. However, the constraints that require the need for "observers" to talk about the problem mean that not all options are available and that we are forced to be in a 3-dimensional space. All other alternatives would be without life. If scientists in another universe knew our laws, but not the number of dimensions we live in, we could carry out that number from the very fact that we exist.

In the end, we have seen that Whitrow's approach to the question of why the space has 3 dimensions leads to far-reaching conclusions as to how and why the 3-dimensional world with one arrow of time is special. Alternatives are too simple, too unstable or too unpredictable for the evolution of complex observers and their survival in them. As a result, we should not be surprised that we live in 3 dimensions of space that are subjected to mercy and unpleasantness to one time. There seems to be no alternative.

Duško Milinčić, El. Engineer, prof. informatics,
Banjaluka, 08/26/2018.

The view of physics

In an extremely interesting and wide circle of readers to an accessible book, the author presents us in a new and simpler way the extremely interesting topics in physics and mathematics, some of which were already in his previous books to the details interpreted. What are the factors of the decisions that we make as conscious beings, and the very nature that we cannot control? It is shown that the whole matter is obeyed by laws that we can describe and interpret in mathematical language. From the many topics just announced, I will say something about some of them.

The perception of freedom

One of the earlier topics is a very interesting perception of freedom. What is the freedom we have and what it represents? We know it is limited by the laws and organizations that determine our behavior. On the one hand, there is the ability to use the given options that an individual has or so-called "Intelligence" of the individual, and on the other hand is the "hierarchy" itself of the environment, which limits the individual's options. One is freedom, and the other is unfreedom, and they always come in pairs. Multiplied pairs in the collection give information of perception, freedom or vitality. It is interesting to note that the fewer restrictions or disadvantages that an individual encounters, which also involves avoiding the constraints and conflicts that can be encountered, the individual is less free, or we can say, less alive. This is in favor of the very well-known fact that people who do not flee from the conflict, but on the contrary, enter with boldness in life become more successfully and happier. Thus man manifests himself in the obstacles he encounters, which we again associate with creativity and so with freedom.

Also, these considerations can be linked to, well-known in science, Heisenberg's relations. On the one hand, we can measure the position of the particle, but what it is more accurately measured, we lose on the precision of the measurement of the momentum, or the speed of the particle itself. Therefore, there is freedom of measurement, but there is also a limit on how much measurement we can detect the behavior of this quantum particle. This limitation is in the inaccuracy of the measurement itself. Measuring these imprecisions that occur, or errors, determines the information of the perception that we receive by measuring. Moreover, all the measurements that are done in the science at all are determined by the limitations, which we express in the form of measurement errors.

It is interesting that the principle of uncertainty lies at the basis of many explanations of the phenomenon, or gives us much information precisely because of its "indeterminacy". For example, atoms representing negatively charged electrons circling around a positively charged nucleus should not be in such a stable configuration as these two opposing charge electrons attract each other, which would naturally lead to collapse of the atom itself. Here, they climb into the help of the uncertainty relation: if the electron goes too close to the core, then its position in the space is too precisely known, and therefore the error of measuring its position is negligible. This means that the measurement error of the electron momentum (and therefore its velocity) is enormous. In this case, the electron could move so rapidly that it is completely freed from the atom, thus leaving the atom losing its structure or its identity.

Heisenberg's relations give an explanation of nuclear alpha decomposition too, whereby alpha particles (2 protons and 2 neutrons) are released from heavy nuclei. An example is uranium-238. The alpha particles are otherwise attached within heavy cores and it is necessary to deposit a large amount of energy in order to get them released from the core. But since the alpha particle inside the nucleus has a very precise speed, its position is not precisely determined. This means that there is a small, but different from zero, the chance that particle particles will be found outside the nucleus, although the required release energy is not given. This really happens in the famous phenomenon of quantum tunneling, where the particle manages to pass through the barrier of the nucleus and is released, which you cannot otherwise skip (because of the lack of energy that comes from its capture). And this tunneling through the barrier is an explanation of the occurrence of this type of radioactivity.

Perhaps the most unusual result of the uncertainty principle is vacuum. We define it as the absence of matter, or empty space. However, in quantum theory, there is an inherent uncertainty in the amount of energy that occurs in quantum processes and the time interval in which this process takes place. This is also another form of uncertainty relations given as a product of the indeterminacy of the said energy and time, which give the same values as the products of the uncertainty of the momentum and the position of the quantum system (particles). It is also true that the more limited is one variable, the other is less variable. It is therefore possible, for very small time intervals, that the energy of the quantum system can be very vague, so vague that the particles can emerge from the vacuum itself. These are actually pairs of particles (matter) and antiparticles (antimatters), e.g. electron and positron. They occur in a short time interval and then mutually cancel (annihilate).

Therefore, the uncertainties that represent the limitations of matter imposed by the very nature of matter are also reflected in this, for quantum mechanics, the key Heisenberg relation, which gives us the perception of quantum processes, without which there would be no information, that is, the existence and freedom of the very nature itself.

About dimensions

The dimensionality of the Universe is set as one of the contemporary scientific questions, is also explained in this book. How to determine dimensionality? The engineer would have found the dimensions by measuring the length and determined that there were three. By using geometric figures, a mathematician could, by extrapolation, conclude that there are infinitely many edge lines of these figures, which actually determine the dimensions. A physicist, from a third angle, observing the Universe and the gravitational attraction that depends on the square of the distance of celestial objects, could conclude that there are three dimensions. However, in mathematical equations describing the propagation of light from these objects through the Universe, there are up to four dimensions. And then he realizes that by connecting the theory of gravity and light, there are at least ten dimensions.

However, the Universe is not just a space. The mathematician Minkowski showed that what physicist Einstein in his Special Theory of Relativity postulated to explain how light is moving at a constant speed in relation to all observers, is best expressed in four dimensions. Instead of separate space and time, he proposes space-time as a unified view of the Universe. In the General Theory of Relativity, Einstein uses this concept and describes gravity using the dynamic four-dimensional model of the Universe. According

to this theory, the space can be increase, decrease, and bent. If one dimension were decreased at a size smaller than the atom, we would not have seen it. But if we could look at a scale that is small enough, that hidden dimension could become visible. An example is the acrobat that runs along a taut rope. It can only move forward and backward, but not left and right, nor up and down, so that it sees only one dimension. Ants that are much smaller in size, i.e. smaller than rope, can move around the rope, and acrobats seem to have an additional dimension there.

The light that we have mentioned originates from electromagnetic interactions. However, for years, scientists have tried to unify this interaction with the remaining three – strong and weak nuclear and gravitational interactions – in the elegant theory of fundamental forces. The mathematician Kaluza and physicist Klein were, independently one of another, where among the first proposers of the unification of electromagnetism and gravity by adding another dimension. Klein explained that this fifth dimension is not noticeable because it is shrunk in a loop of the order of 10^{-33} centimeter. His contemporaries chose to explore the existence of internal (abstract, i.e. mathematical) dimensions rather than physical ones. This creates the famous Hilbert space, which uses an infinite number of mathematical dimensions into which an unlimited number of quantum states can be placed. However, the expansion of the four-dimensional into the five-dimensional space for the inclusion of electromagnetism was unsuccessful for Einstein. A few years later, the famous Theory of Strings appeared according to which all the fundamental structures of nature are actually vibrating strings of energy. Mathematical representation gives 10 or more dimensions. This theory is further developed into the so-called M-theory, which includes energy membranes, besides strings. This actually opens the possibility of having a large dimension, which could be observable. This dimension could solve the hierarchy problem that exists in fundamental interactions, where gravity is much weaker than other forces of nature. For example, electromagnetism: If we raise a steel object with a small magnet, we see that magnetic attraction is stronger than the gravitational attraction of the whole Earth. In membrane theory, in reality there are two membranes that are separated by a gap (analogy: the Great Canyon in Arizona). As tourists gather at the edges of the canyon, the particles are also collected on the membranes. As a consequence, the physical world is placed on them. However, climbers can move beyond that edge, and also gravitons (particles of gravity carriers) are an exception and can also move in the space between the membranes. Since gravitons spend much less time interacting with the membrane, gravity is much weaker than other forces. Therefore, the existence of more dimensions would explain why the gravity is much weaker than the other fundamental forces. One possibility is that part of the gravitational effect extends through these additional dimensions.

How to discover additional dimensions? For example, by finding particles that can exist only if the additional dimensions are real. The idea of dimensionality has continued to evolve, until today, where, in the famous Large Hadron Collider (LHC), a particle accelerator at the French-Swiss border, it works, among other things, to detect possible new dimensions. Since the discovery of the Higgs boson in 2012, by which the Standard Particle Model is completed, the quest for new dimensions becomes one of the central tasks. There is several potential crashes (collides) events that could lead to the discovery of new dimensions.

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Theories claim that additional dimensions predict the existence of heavier versions of the particles from the Standard model in other dimensions, as atoms have their energy states – the basic with the lowest, and the excited with higher energies. These heavier versions are called Kaluza-Klein states and they will have the same properties as standard particles (which would be visible to detectors) but with higher mass. If CMS (Compact Muon Solenoid) and ATLAS (A Toroidal LHC Apparatus) find Z or W bosons (particles of electro-magnetic force carriers) weighing 100 times, this would mean that there are additional dimensions. Such particles can be detected only at the high energies that reach the LHC.

If gravitons exist, it should appear in the LHC and quickly disappear in additional dimensions. Particle collisions in accelerators cause movement of the particles in all directions. Graviton can therefore avoid the detector and thus leave an empty zone, which is seen as an imbalance in the momentum or energy of that collision. It is necessary to examine whether the graviton has escaped to another dimension or is something else in question.

One of them is the creation of microscopic black holes, which are predicted in the theories of higher dimensions. What exactly would be detected depends on the characteristics of the black hole itself, i.e. the dimensions, the energy in which they occur, etc. If they occur, they disappear in a fraction of a second, in a particle of the Standard Model, which leads to a huge number of traces in the detector that can be spotted.

If additional dimensions really exist, they could explain why the universe is expanding faster than expected.

Aleksandra Radić, prof. physics
September, 2018.

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